



Technical Memorandum

Operable Unit 1 Demonstration Study Progress Report

September 2005 to February 2006

National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California

Final

April 2006

This technical memorandum provides a summary of field, analytical, and operational data collected September 1, 2005 through February 28, 2006 for the Operable Unit 1 (OU-1) demonstration study system. The OU-1 system is being implemented as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) in Pasadena, California.

This memorandum summarizes system performance based on the extracted and reinjected groundwater volumes, volatile organic compound (VOC) removal, and perchlorate removal. Other operational issues discussed include actions taken to monitor and mitigate sulfate reduction (and hydrogen sulfide generation) from the OU-1 system. The performance of the biomass removal and backwash recovery system during this timeframe is discussed. In addition, an assessment has been performed to evaluate the water levels and water quality data collected within the OU-1 target treatment zone. The following attachments are included:

- Attachment A. Field Monitoring Results
- Attachment B. Laboratory Analytical Results

System Performance Summary:

Table 1 summarizes the performance of the OU-1 system through February 28, 2006.

Table 1. OU-1 System Operational Summary (Through February 28, 2006)

Parameter	Units	EW-1	EW-2	Total
Total Volume of Groundwater Extracted	Acre Feet	87	121	208
Total Volume of Wastewater to Sewer	Acre Feet	–	–	0.18
Mass of Perchlorate Removed	lb	200	232	432
Mass of CCl ₄ Removed	lb	2.5	7.5	10
Mass of TCE Removed	lb	0.6	1.3	1.9

System performance is discussed below in terms of the extraction well flow rates, injection well flow rates, wastewater discharges, and the overall mass removal achieved:

- **Extraction.** The OU-1 system has operated at an average extraction flow rate of 155 gallons per minute (gpm) and has extracted approximately 208 acre-ft of water through February 28, 2006. The flow rate from Extraction Well No. 1 (EW-1), the shallow well,

has varied from 60 to 87 gpm with an average value of 65 gpm. The flow rate from EW-2 (the deep well) has varied from 67 to 97 gpm with an average value of 90 gpm.

- **Reinjection.** Sustained reinjection flow rates have been achieved at Injection Well No. 1 (IW-1) at a level up to 98 gpm with an average value of 63 gpm. The pressure at the IW-1 wellhead has ranged from 0 to 31 pounds per square inch (psi) with an average value of 15 psi. Sustained reinjection flow rates have been achieved at IW-2 at levels up to 130 gpm with an average value of 108 gpm. The pressure at the IW-2 wellhead has ranged from 0 to 22 psi with an average value of 8 psi.

In December 2005, IW-2 was rehabilitated due to increased pressure and reduced flow. Just before rehabilitation, well head pressure was at 21 psi and flow was limited to 80 gpm. Post rehabilitation, the IW-2 wellhead was at 0 psi and could handle up to 150 gpm. The condition in IW-2 four weeks after rehabilitation yielded a wellhead pressure of 10-15 psi and flows of 100-125 gpm. Rehabilitation of IW-1 is planned for the Spring 2006.

- **Wastewater Discharges.** The amount of wastewater discharged to the sanitary sewer during this operating period was 45,000 gallons, or approximately 0.14 acre-ft. The total amount of waste water discharged over the course of the OU-1 operation is 57,000 gallons or approximately 0.18 acre-ft. Discharges to the sanitary sewer are currently occurring once every 4 weeks.
- **Mass Removal.** The total cumulative chemical mass removed by the OU-1 system through the end of February 2006 was estimated at 432 lb of perchlorate, 10 lb of carbon tetrachloride (CCl_4), and approximately 2 lb of trichloroethene (TCE). Figure 1 shows the cumulative perchlorate removal over time for the OU-1 system. The mass removal estimates were based on the amount of groundwater extracted during each month from each well, the monthly average influent perchlorate concentration from each well, and the monthly average influent CCl_4 and TCE concentrations from each well.

VOC Removal by Liquid-Phase Granular Activated Carbon

Liquid-phase granular activated carbon (LGAC) is used to remove VOCs from the groundwater, and the LGAC vessels are arranged in a lead-lag configuration. Samples were collected on a weekly basis from each extraction well, the combined LGAC influent, the LGAC lead vessel effluent, and LGAC lag vessel effluent. Samples were analyzed for VOCs and 1,4-dioxane (see Attachment B).

The total VOCs in the combined LGAC influent ranged from <1.0 to 35 $\mu\text{g}/\text{L}$ during this time period. CCl_4 represents the highest fraction of the influent total VOCs and ranged from 8.8 to 24 $\mu\text{g}/\text{L}$ during this time period. Figure 2 shows an overall declining trend in the influent total VOCs over time in both wells and in the combined influent. The VOC concentrations in EW-1 are lower than those in EW-2 and have declined at a faster rate with total VOCs in EW-1 reaching non-detect concentrations in late November. Figure 2 also shows the August 10, 2005 breakthrough of CCl_4 in the lead LGAC vessel. On November 1, 2005, the lead LGAC vessel was changed out and the lag vessel moved to the lead configuration; this change out yielded

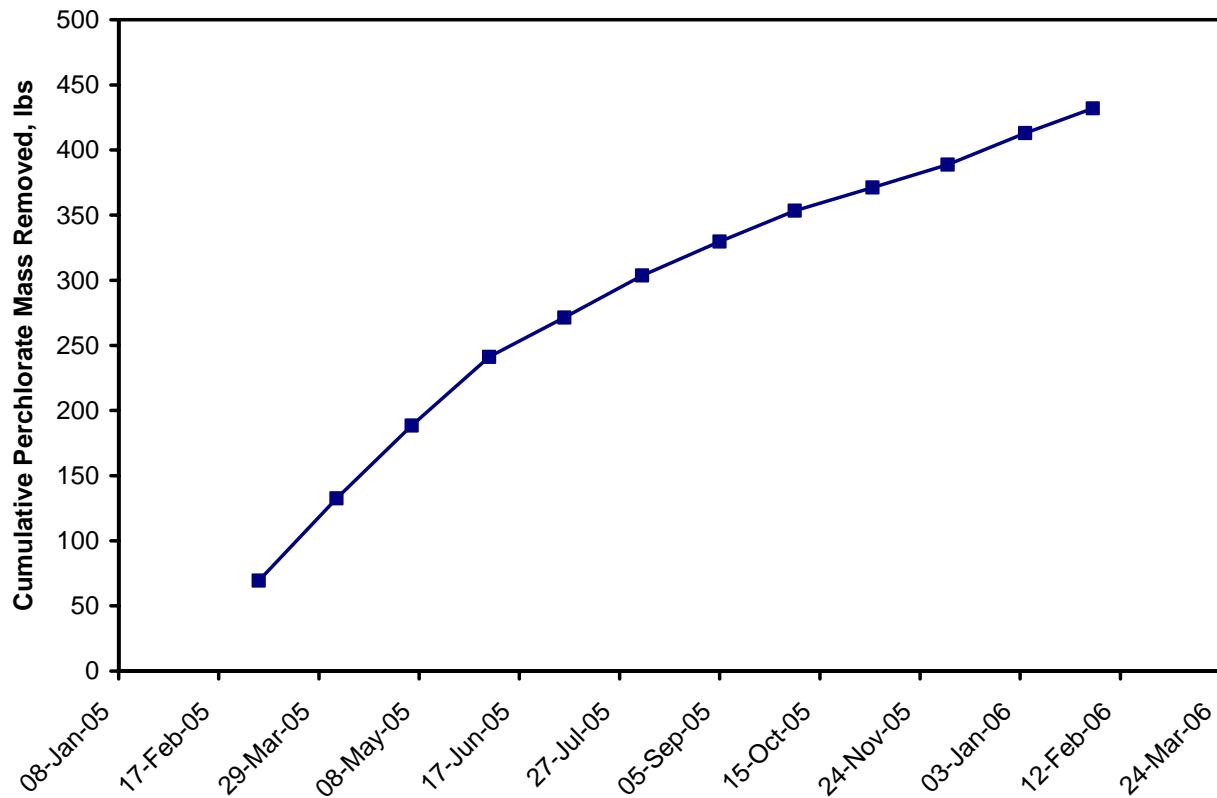


Figure 1. Cumulative Mass of Perchlorate Removed by the OU-1 System

perchlorate absorption for approximately 5 weeks. All carbon change outs, to date, have yielded perchlorate absorption by the LGAC units. In early February, a <2.0 µg/L concentration of chloroform was detected at the LGAC lead vessel effluent (e.g., midway point of the LCAG vessels), but the lead vessel was not changed as chloroform is not currently being used as part of the criteria for LGAC change out. All other VOCs present in the extracted groundwater were below the detection limit in the effluent from the lag LGAC vessel.

Nitrate and Perchlorate Removal by the Fluidized Bed Reactor (FBR)

Nitrate and perchlorate biodegradation occur within the FBR when the dissolved oxygen (DO) concentrations are low (<1 mg/L), the oxidation reduction potential (ORP) indicates reducing conditions, and there is an adequate supply of electron donor (acetic acid) and nutrients (urea/diammonium phosphate). The end products of treatment within the FBR are biomass, carbon dioxide, water, nitrogen, and chloride. A summary is provided below of nitrate and perchlorate removal in the FBR through February 28, 2006. Also discussed are data related to ORP conditions and sulfate reduction within the FBR.

During this timeframe, the total flow rate of the FBR ranged from 1,055 to 1,258 gpm with an average value of 1,166 gpm. At an average value of 160 gpm for the forward feed, this represents an 87% recycle rate within the FBR. The fluidized bed height has ranged from 14.0 ft to 18.0 ft during this timeframe.

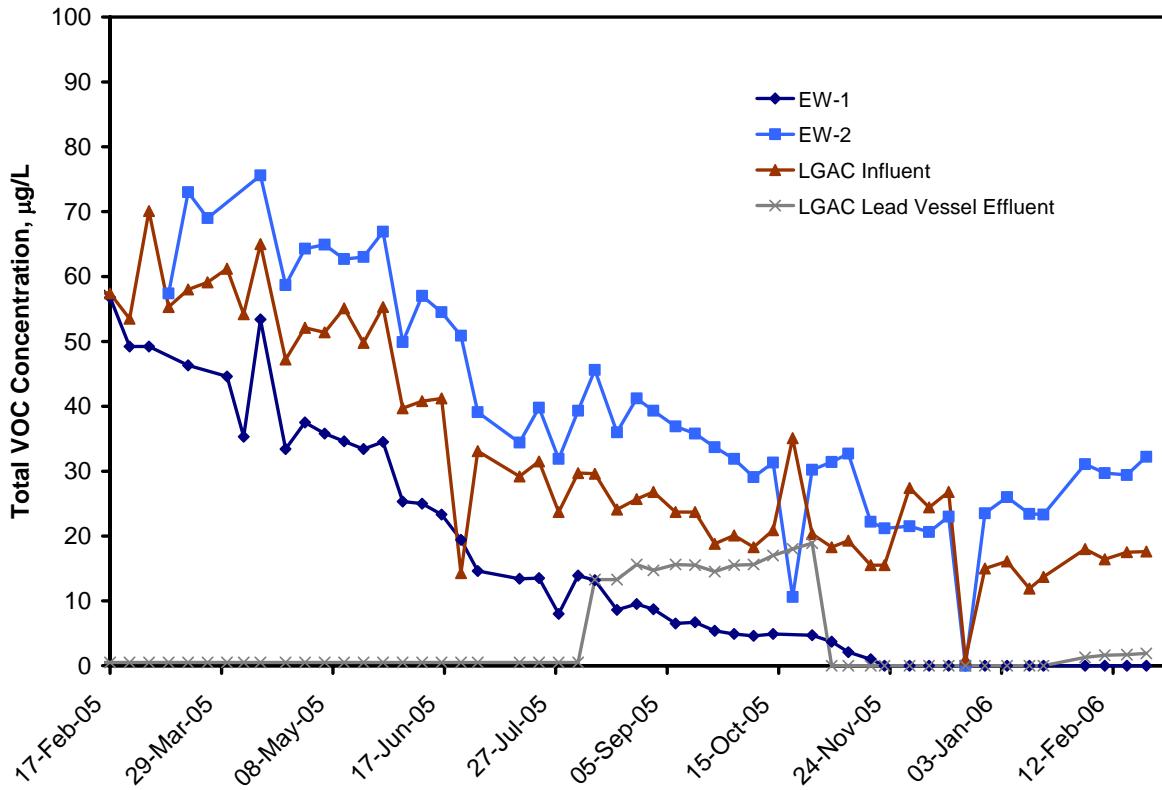


Figure 2. Total VOC Influent and Effluent Concentrations

Nitrate Removal. Figure 3 shows the nitrate concentrations in the extracted groundwater from EW-1 and EW-2 and in the combined plant influent over time. The figure shows an overall declining trend in the plant influent nitrate concentration from greater than 9 mg/L at the start of plant operations in February 2005 to 3 mg/L a year later. The dissolved oxygen, nitrate, and perchlorate concentrations in the extracted groundwater are the parameters that determine the acetic acid demand within the FBR. As the influent nitrate and perchlorate concentrations have decreased over time, the acetic acid concentrations have been manually adjusted on a weekly basis to match the changing influent conditions.

Figure 4 shows the influent and effluent nitrate concentrations across the FBR over time. It is important to optimize nitrate removal because nitrate-reducing conditions must be achieved before perchlorate removal occurs. As Figure 4 shows, the percentage of nitrate removal has varied from 72% to 96%, depending on the influent nitrate concentrations and the acetic acid dose applied to the FBR, with an average value of 89%. From September 2005 to February 2006, the FBR influent nitrate concentration ranged from 1.7 to 3.5 mg/L with an average value of 2.7 mg/L. During this timeframe, the FBR effluent nitrate concentration ranged from <0.25 to 0.7 mg/L with an average value of 0.30 mg/L.

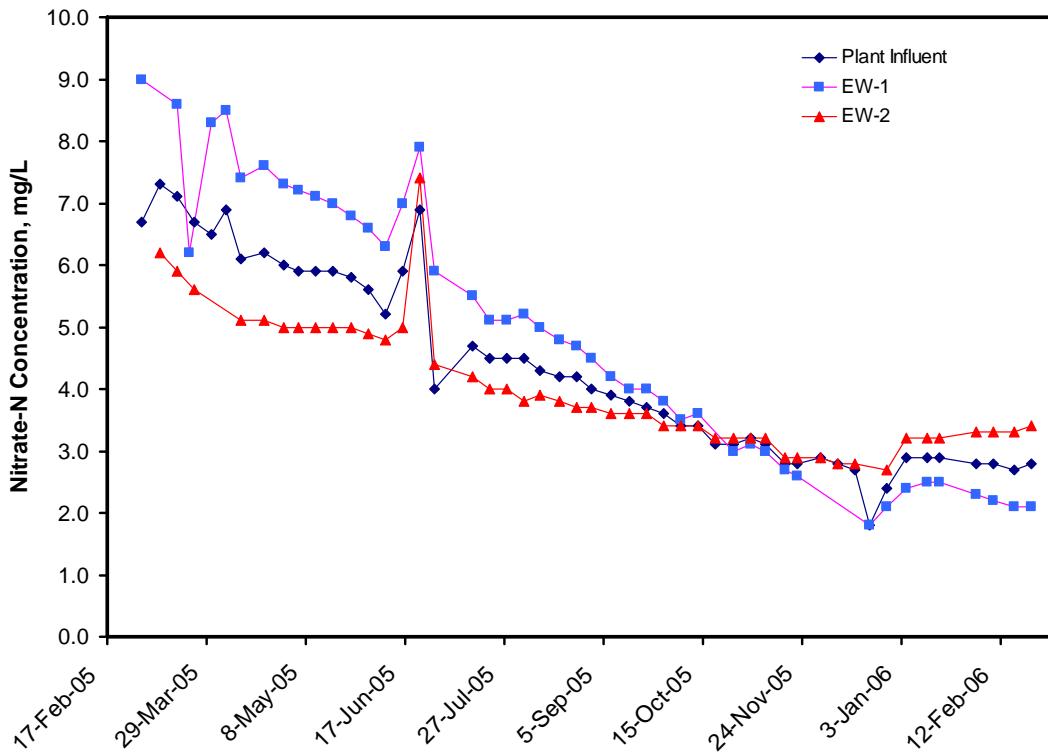


Figure 3. Influent Nitrate Concentrations at EW-1, EW-2, and Combined Plant Influent

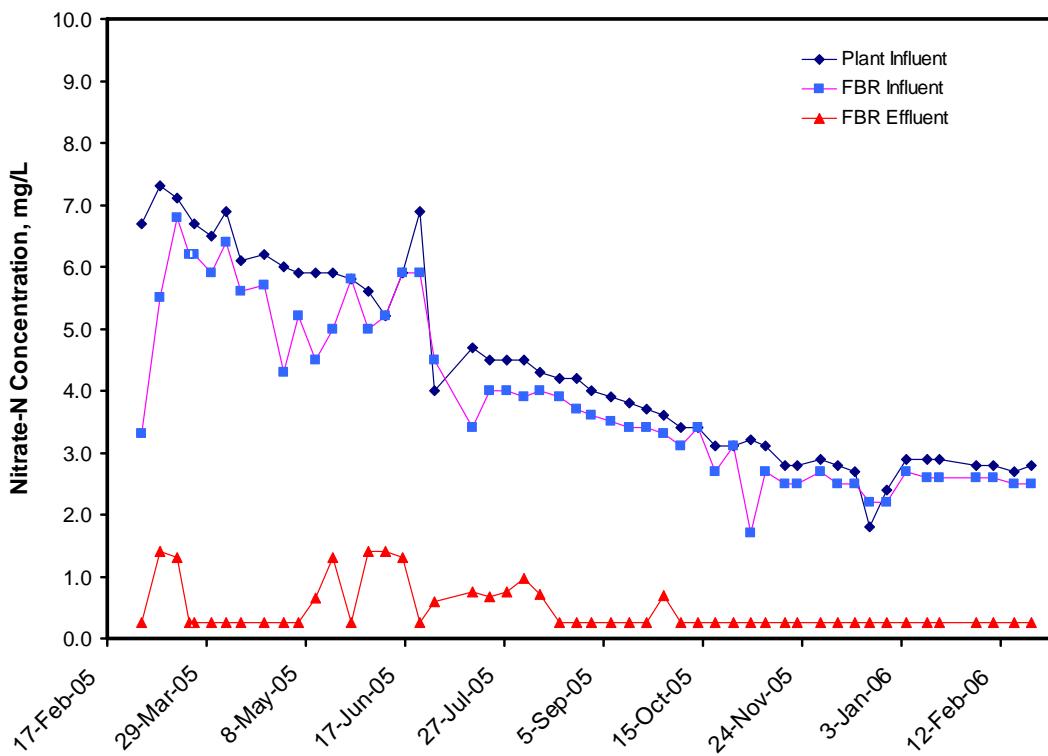


Figure 4. Nitrate Removal by the FBR

Perchlorate Removal. Figure 5 shows the perchlorate concentrations in the extracted groundwater from EW-1 and EW-2 and in the combined plant influent over time. Figure 5 shows an overall declining trend in plant influent perchlorate concentrations, from 2,300 µg/L in February 2005 to an average value of 391 µg/L in February 2006. EW-1 initially had slightly higher influent perchlorate concentrations than EW-2 in the extracted groundwater. However, currently the perchlorate concentrations within EW-1 are lower than EW-2. Perchlorate concentrations averaged 242 µg/L for EW-1 and 525 µg/L for EW-2 in February 2006.

Figure 6 shows the influent and effluent perchlorate concentrations across the FBR over time. The percentage of perchlorate removal was 100% within the period, with two exceptions during this reporting period. During the timeframes of September 15, 2005 and September 29, 2005, the acetic acid dosage was lowered from 12.5 gallons per day (gpd) to 10.5 gpd to counter the excess sulfide production that was monitored within the reactor. This change in dosing did lower the sulfide production, but it was insufficient for complete perchlorate removal. During this time, the effluent perchlorate concentrations ranged from < 2 µg/L to 360 µg/L, corresponding to a removal rate of approximately 50-60%. Another exception occurred on December 28, 2005, resulting in a perchlorate effluent concentration of 151 µg/L, and was a result of problems associated with the overdosing by the electron donor pump. It was determined that this overdosing of the acetic acid resulted in a reduction of perchlorate reducing bacteria and an increase of sulfate reducing bacteria within the FBR. This situation and the impact on system operation are outlined below:

- During January 11-19, 2006, acetic acid dosing averaged 15-17 gpd, an increased dosing to compensate for the perchlorate breakthrough seen on December 28, 2005. In the latter part of the week of January 23, it was noted that the OU-1 system was under-performing. The field lab data showed that sulfide concentrations in the FBR effluent water exceeded normal concentrations and ranged up to 1,000 µg/L. Perchlorate was not being completely removed by the FBR, as field data indicated that the perchlorate was entering into the FBR at concentrations of 300 to 400 µg/L and exiting at concentrations of 100 to 200 µg/L. Additionally, nitrate concentrations were entering the FBR at concentrations of 2,000 to 3,000 µg/L and leaving the FBR at concentrations of 2,500 µg/L (Attachment A).
- Acetic acid dosing was at approximately 12-12.5 gpd, a dose that historically was sufficient for full nitrate and perchlorate removal and normally allowed the FBR effluent ORP concentrations to reach -150 to -200 mV. Figure 8 shows the relationship between ORP and the perchlorate concentrations. During the week of January 23-27, 2006, the ORP was -275 to -290 mV, much lower than expected, and the extra sulfide production was causing high H₂S production. The acetic acid dosing is shown on Figure 7.
- To return the FBR to its steady state condition, the system was placed into a recycle mode, the reactor was manually dosed with nitrate, and the addition of acetic acid was stopped. The batch dosing of nitrate removed excess acetic acid from the reactor and increased the nitrate/perchlorate reducing bacteria while decreasing the population of sulfide producing bacteria. Battelle ran a series of batch dosing events for 2 days until sulfide production was minimized and nitrate/perchlorate removal was maximized.

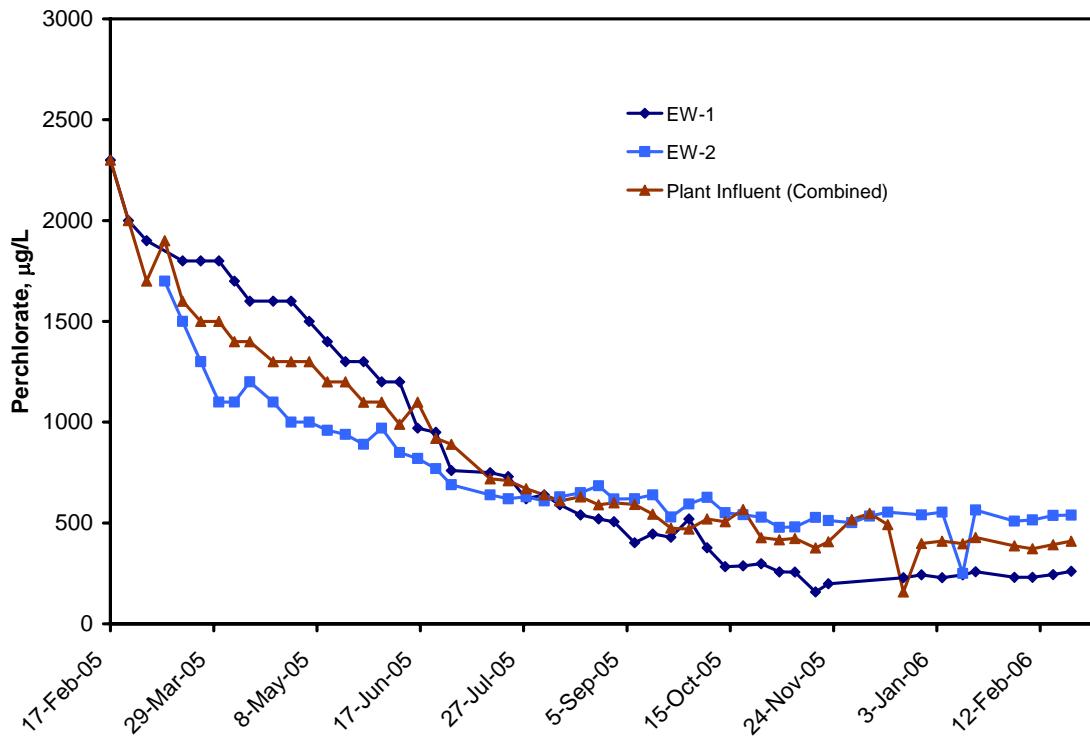


Figure 5. Influent Perchlorate Concentrations at EW-1, EW-2, and the Combined Plant Influent

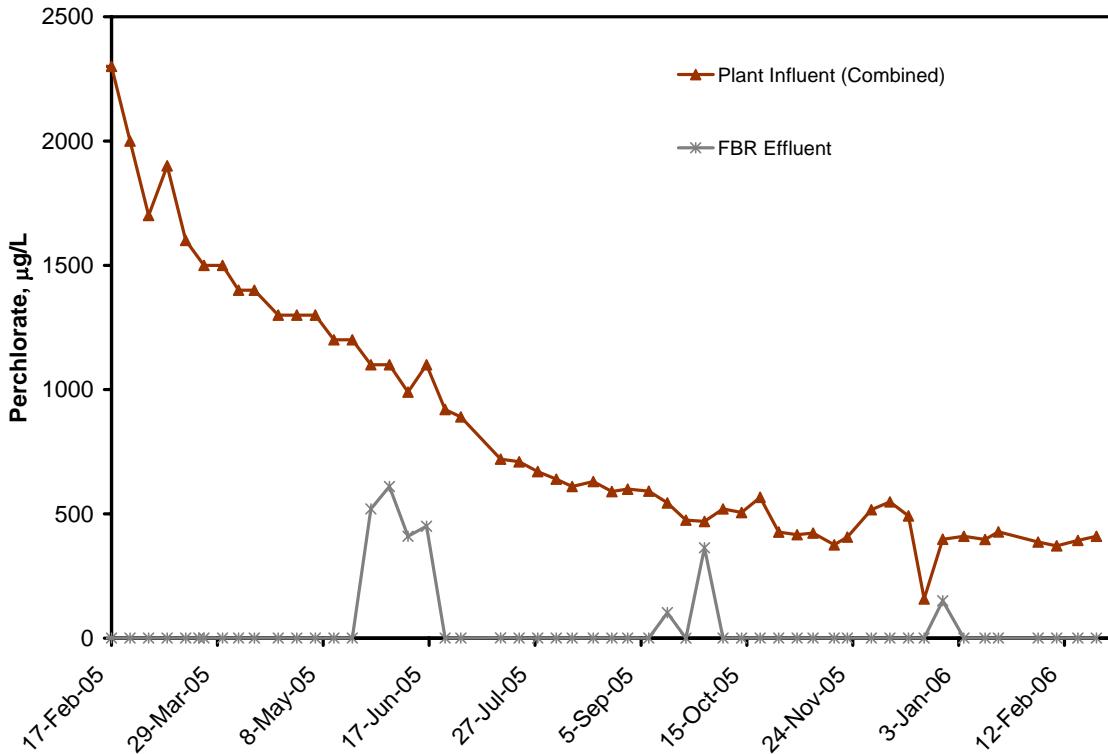


Figure 6. Perchlorate Removal by the FBR

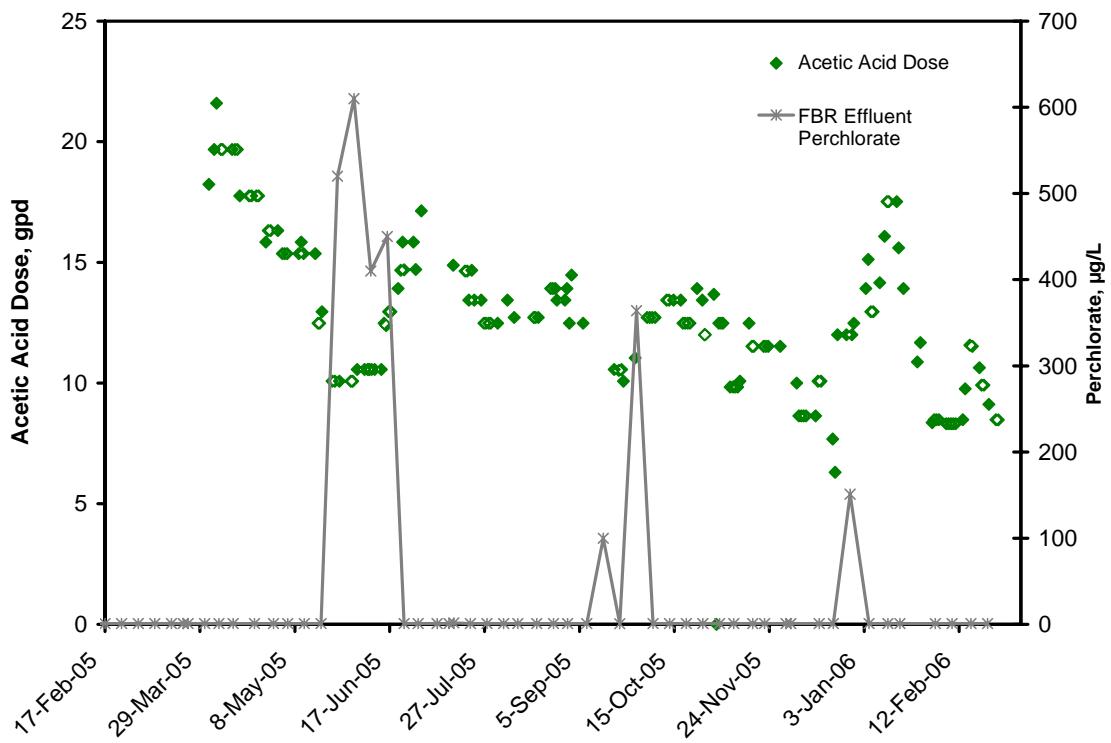


Figure 7. Acetic Acid Dosage Rate and FBR Effluent Perchlorate Concentrations

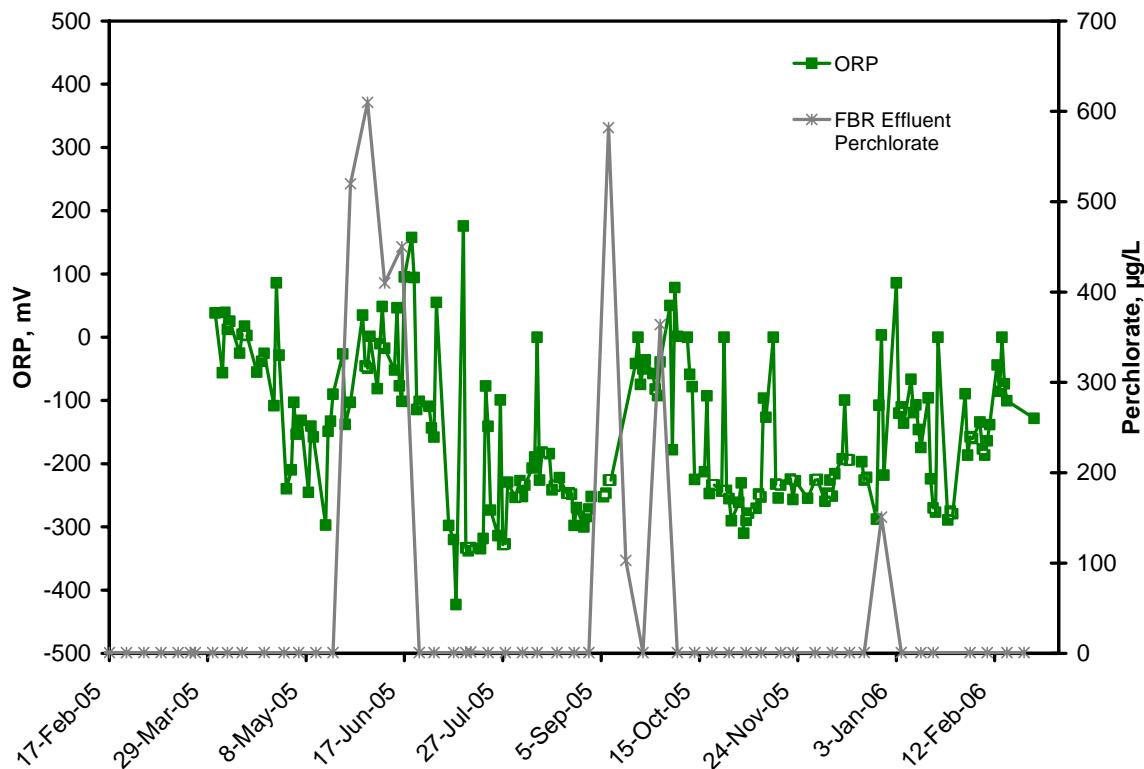


Figure 8. ORP Conditions and FBR Effluent Perchlorate Concentrations

The perchlorate reporting limit for the analytical laboratory is 2 µg/L using Method 314, but the laboratory's calibration procedure allows detections to be estimated in the range of 0.5 µg/L to 1 µg/L, depending on the sample conductivity and other factors. The analytical laboratory has reported only one estimated detection of perchlorate at 0.77J on September 22, 2005, which occurred in the FBR effluent sample (see Attachment B).

ORP Conditions and Sulfate Reduction. Under normal operations, the biological treatment unit at the OU-1 treatment plant will convert small amounts of natural sulfate in the groundwater to dissolved hydrogen sulfide (H₂S). During certain upset conditions, larger amounts of H₂S can be generated. Hydrogen sulfide can create a noticeable odor at a threshold value of 0.001 parts per million by volume (ppmv) in the ambient air.

Figure 9 illustrates the relationship between ORP concentrations and total sulfide in the FBR effluent, which is a product of sulfate reduction. Total sulfide measurement is completed on-site using a Hach™ spectrophotometer which indicates the total quantity of H₂S, HS-, and metal sulfides in a sample. Based on the neutral pH of the treated water, it is assumed that the majority of the total sulfide is present in the form of H₂S. As discussed above, during the week of January 23, 2006 a significant concentration of sulfate reduction within the FBR had resulted in H₂S production. The H₂S treatment vessels were not removing all concentrations of H₂S and odor was detected in the ambient air around the plant. The early breakthrough in the H₂S treatment vessels was attributed to excess moisture within the vessel. Two new vessels were placed in a lead/lag configuration to ensure no further H₂S releases into the ambient air. A new moisture trap was installed in order to prolong the treatment capability of the new H₂S removal system. Daily monitoring of H₂S is being performed to ensure no further releases of H₂S occur.

Figure 9 shows that, as the ORP concentrations within the FBR approach -240 mV, the FBR achieves sulfate reducing conditions and sulfide is produced at concentrations from 100 to >800 µg/L in the FBR effluent based on Hach™ field readings. Figure 9 also shows that detectable concentrations of sulfide can be produced at ORP levels above -240 mV, but the sulfide concentrations typically remain below 100 µg/L in the treated water.

Biomass Removal and Backwash Water Recovery

The biomass removal and backwash recovery system consists of the Trimate™ filter, the backwash sump, and the clarifier. The filter helps to recover biomass solids and to reduce the turbidity of the reinjected treated water to protect the injection wells. Figure 10 shows the effluent turbidity over time from the filter based on Hach™ turbidimeter readings. The effluent turbidity from the filter has ranged from 0.05 to 3.8 nephelometric turbidity units (NTU) with an average value of 0.29 NTU from September 2005 to February 2006. In comparison, wells are typically developed until the recovered groundwater maintains a turbidity of less than 4 NTU.

Table 2 shows the total suspended solids (TSS) load from the FBR to the filter which has ranged from 5 to 250 lb/day. The TSS concentrations entering the filter have ranged from 3 to 130 mg/L with decreasing values over the last 6 months. In September 2005, the influent concentration was at its highest, correlating to an increased FBR bed height and therefore more shearing of biomass by the biomass separators. The TSS concentrations in the filter effluent ranged from < 2.5 to < 4.0 mg/L and the corresponding TSS removal rate was optimal given the

minimum detection limits. In comparison, the influent TSS in the extracted groundwater has maintained concentrations of < 4.0 mg/L.

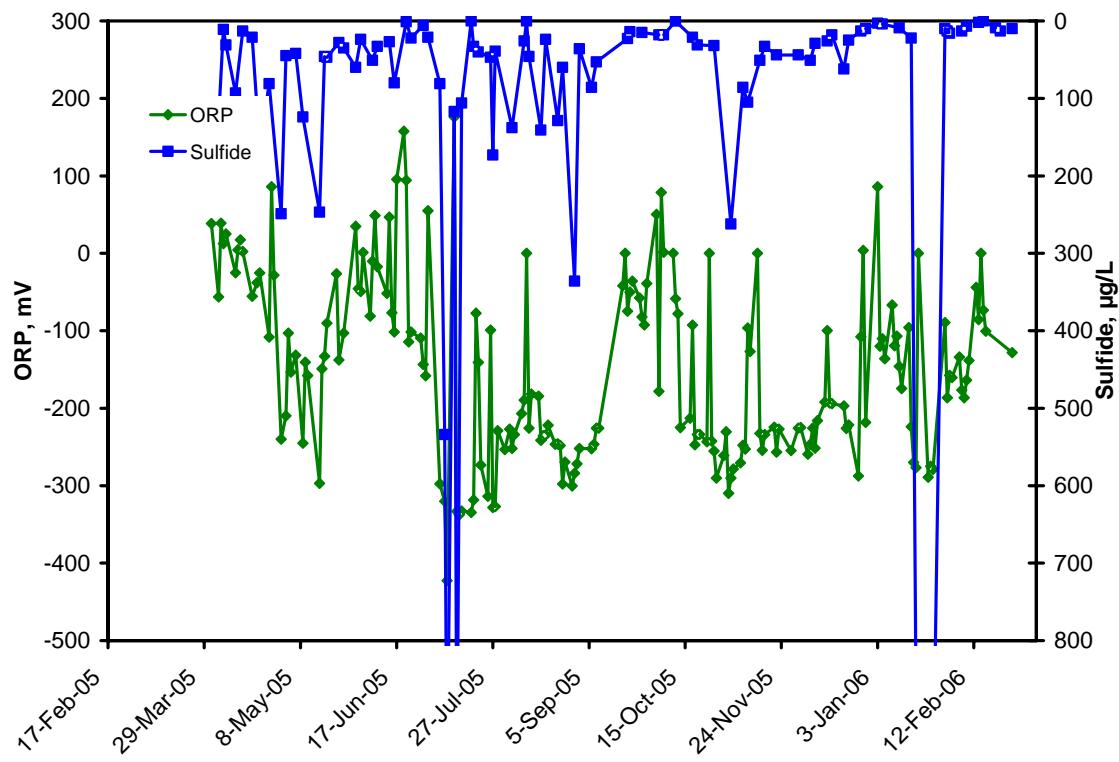


Figure 9. ORP Conditions and Sulfide Concentration within the FBR

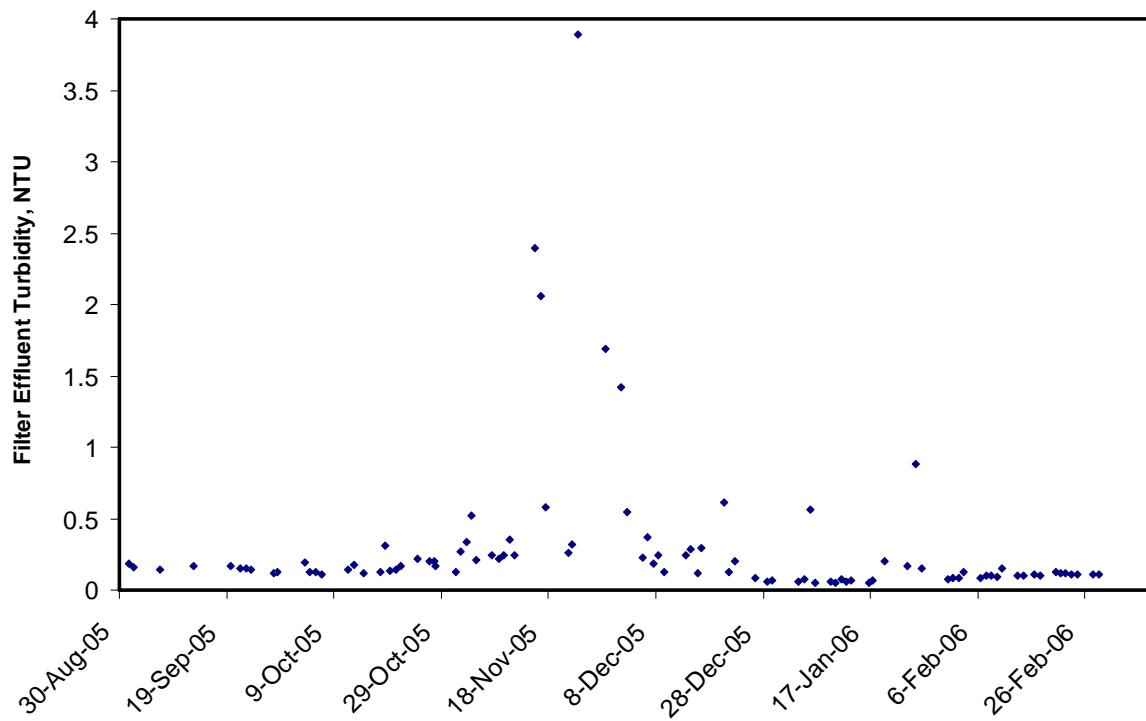


Figure 10. Trimite™ Filter Effluent Turbidity

Table 2. Summary of Biomass Solids Removal from Trimite™ Filter

Date	Filter Influent TSS		Filter Effluent TSS		Percent Removal ^(b)
	mg/L	lb/day ^(a)	mg/L	lb/day	
09/29/05	130	250	<4.0	<7	97-100%
10/27/05	14	27	<4.0	<7	77-100%
12/28/05	3	5	<2.5	<5	0-100%
02/02/06	4	8	<2.5	<5	38-100%

(a) Based on an average flow rate of 160 gpm and 24 hour per day operation.

(b) Ranges given based on Minimum Detection Limit for TSS.

The backwash water from the Trimite™ filter is sent to the sump for storage and returned to the FBR inlet after the biomass solids settle out in the clarifier. Currently, no polymers and/or coagulant aids are being used in the clarifier; rather, the clarifier solids are being discharged at a rate of approximately once every 4 weeks.

Water Level and Water Quality Assessment

Groundwater level elevation and chemical data were used to investigate the impact of the OU-1 system operations on local aquifer conditions. Groundwater level elevation data has been collected quarterly from the NASA JPL monitoring wells and transducers are used to record data from the extraction wells. In addition, groundwater levels are collected on a weekly basis from NASA-JPL monitoring wells MW-7, MW-8, MW-13, MW-16, and IRZ-IW2 as part the OU-1 system operations.

Historic elevation data (April 2004) indicate a steep southwest gradient from the mouth of the Arroyo Seco to the OU-1 system area coupled with a southeast gradient from the northwest of the JPL facility. Flow converges to the south of the treatment system and migrates toward the south/southeast under a reduced gradient (Figure 11). The groundwater elevation contour map showing conditions after system startup (Figure 12) indicates groundwater flow is significantly affected by operation of the system, with a drawdown of roughly 25-30 ft observed in the extraction wells. Although no groundwater level elevation data is available from the injection wells, it appears that that extraction wells will effectively contain groundwater within a 150-ft radius of the extraction wells and the groundwater injected upgradient at IW-1 and IW-2. Graphs of historical groundwater level elevation data in select wells (Figure 13) show a significant seasonal fluctuation and also indicate a significant rise in elevation in the spring of 2005 that is likely due to increased recharge from precipitation. Groundwater levels observed in February 2006 declined approximately six to twenty feet from the April 2005 high level, but are still at or near historical high levels (see Figures 12 and 13). Table 3 compares data from the three previous fourth quarter sampling events (to eliminate seasonality effects) and shows minimal difference between the 2003 and 2004 data and a fairly uniform 20-ft increase in groundwater elevation between the 2004 and 2005 data across the regional aquifer.

Isoconcentration contour maps are provided for TCE, CCl₄, and perchlorate, for baseline conditions before extraction (October/November 2004) and after extraction (October/November 2005) as Figures 14 through 16. Figure 17 is an isoconcentration contour

map showing the nitrate conditions before extraction (May 2004) and after extraction (October/November 2005). The chemicals have declined or remained the same in the wells near the facility's eastern boundary (MW-11) and western boundary (MW-22 and MW-23). These data indicate the following:

- The concentration of VOCs and perchlorate in the treatment zone (i.e., MW-7 and MW-24) has decreased significantly since system start up.
- Concentrations of TCE in the treatment zone are below 1 µg/L.
- Concentrations of CCl₄ in MW-7 are below the 0.5 µg/L.
- Perchlorate concentrations in the MW-7 and MW-24 have declined from 4,810 µg/L and 4,880 µg/L to concentrations of 32.3 µg/L and 104 µg/L respectively.
- Elevated concentrations of VOCs and perchlorate continue to be observed in source area wells MW-13 and MW-16 located outside the demonstration study treatment zone.

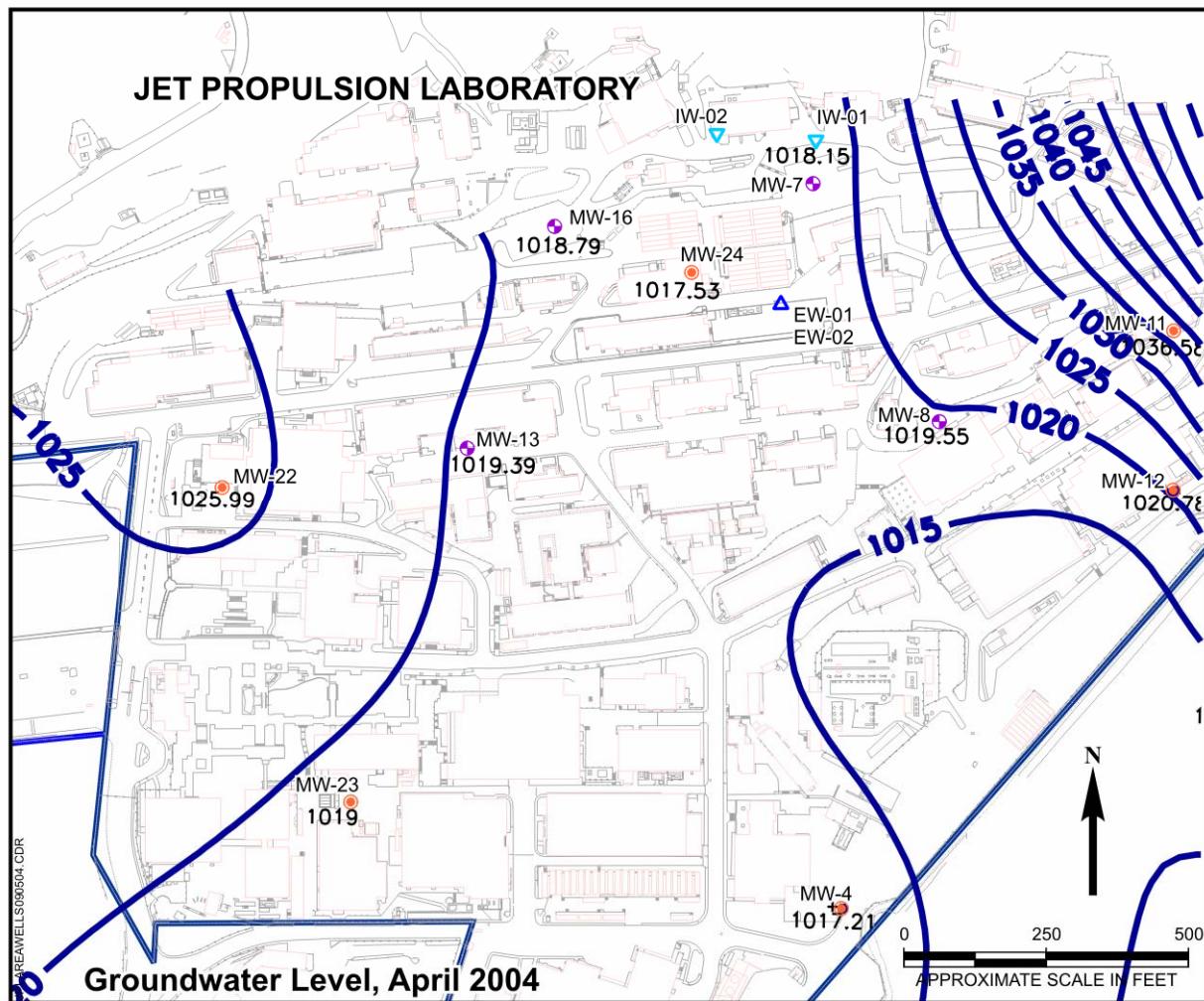


Figure 11. Groundwater Contour Map April 2004 (Baseline Before Extraction)

Table 3. Summary of Groundwater Level Elevation Difference in October Monitoring Events

Statistic	Difference Between October 2004 and October 2003 in all JPL Shallow Screened Monitoring Wells (ft)	Difference Between October 2004 and October 2003 in Nine Wells in OU-1 Area (ft)	Difference Between October 2005 and October 2004 in all JPL Shallow Screened Monitoring Wells (ft)	Difference Between October 2005 and October 2004 in Nine Wells in OU-1 Area (ft)
Average	2.31	1.22	21.79	27.10
Median	0.87	1.79	26.92	26.06

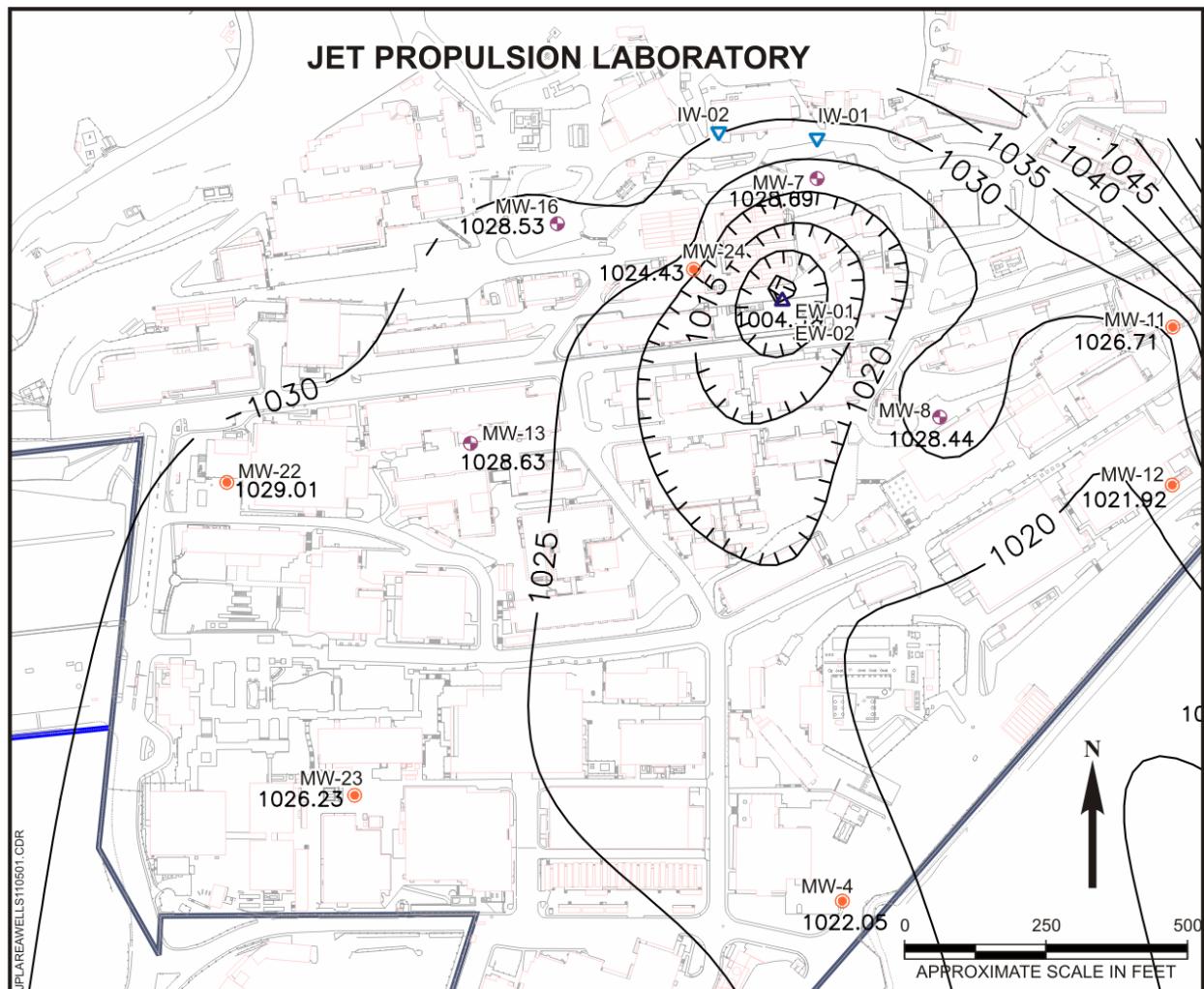


Figure 12. Groundwater Contour Map October/ November 2005 (With Extraction)

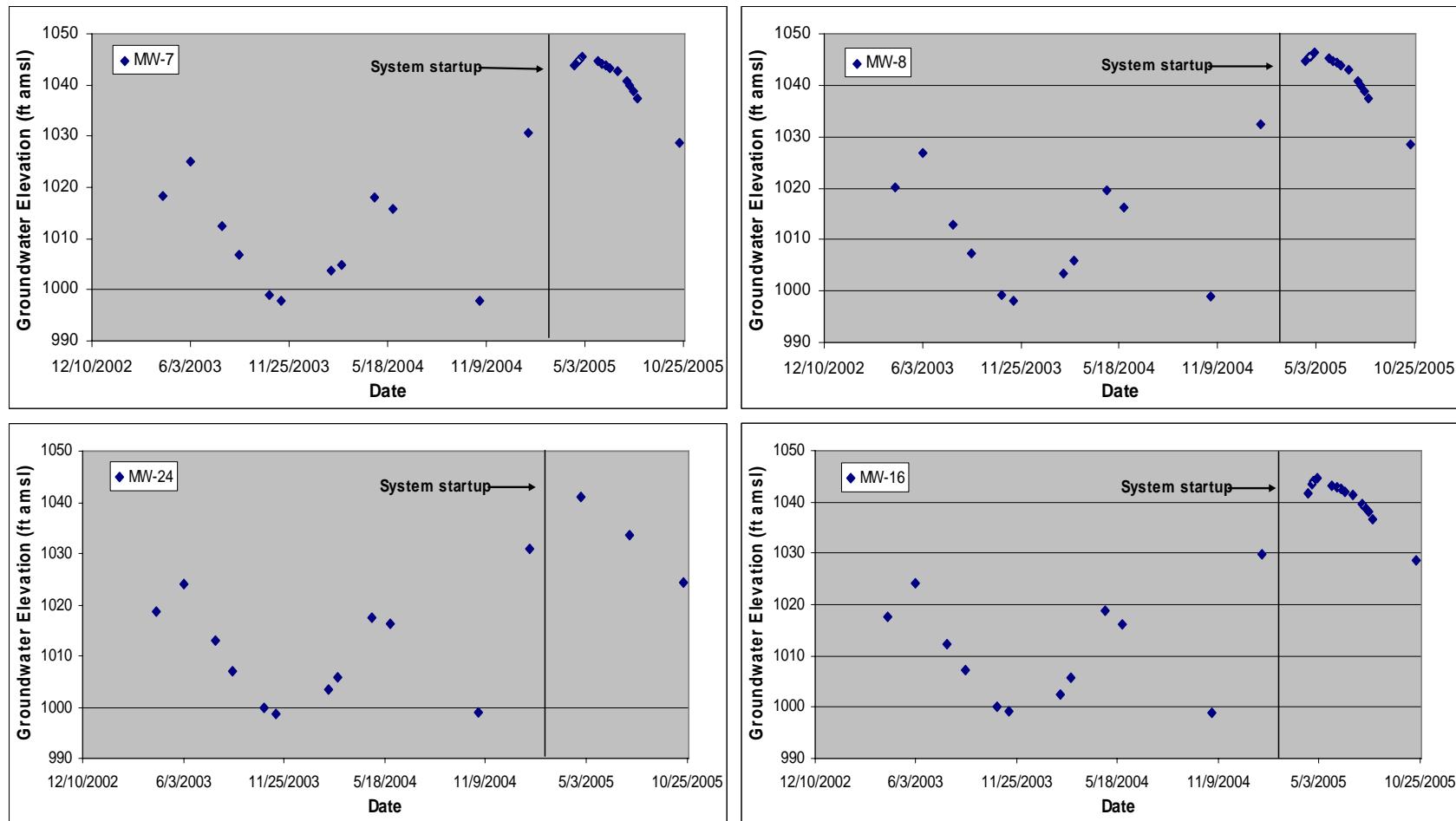


Figure 13. Historical Groundwater-Level Elevations in MW-7, MW-8, MW-24, and MW-16

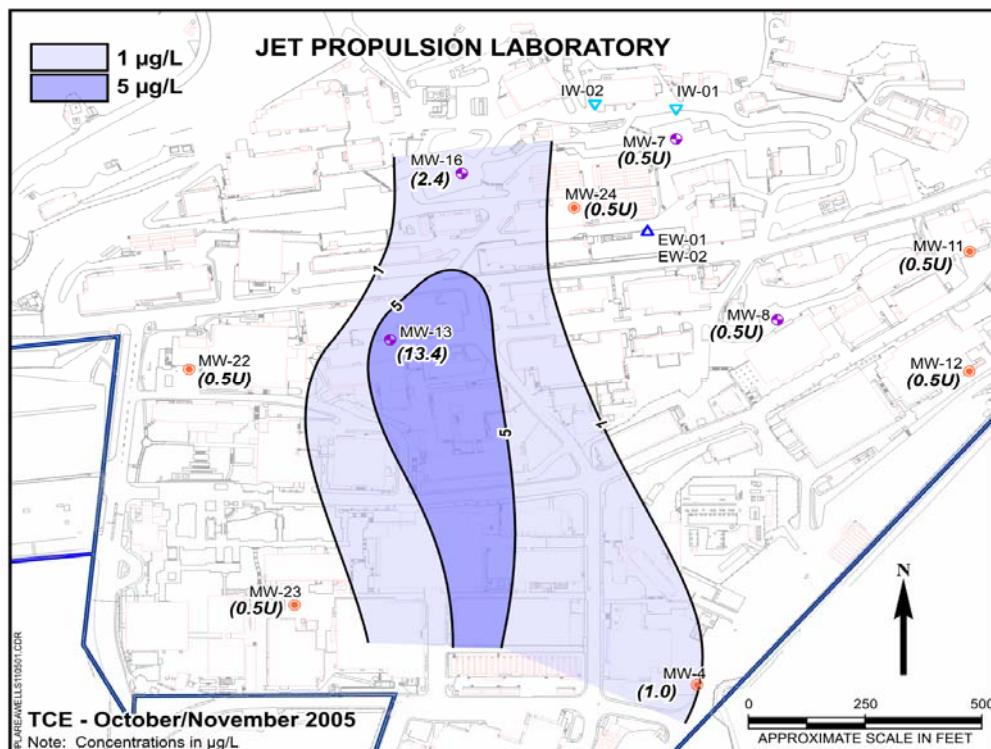
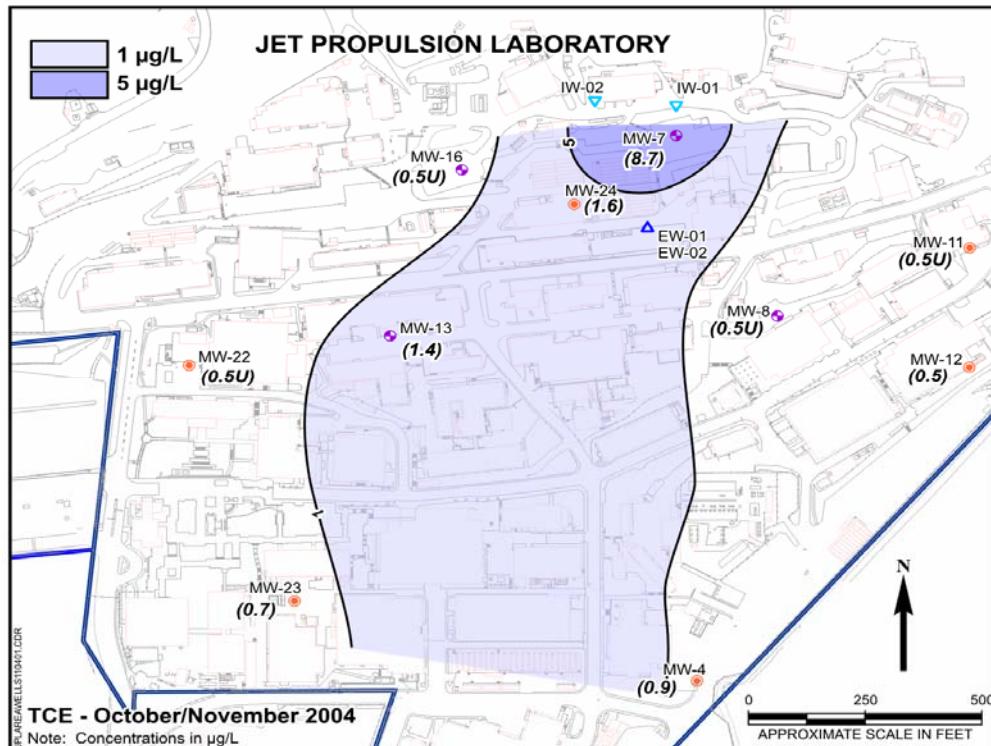


Figure 14. TCE in Groundwater Before (October/November 2004) and After Extraction (October/November 2005)

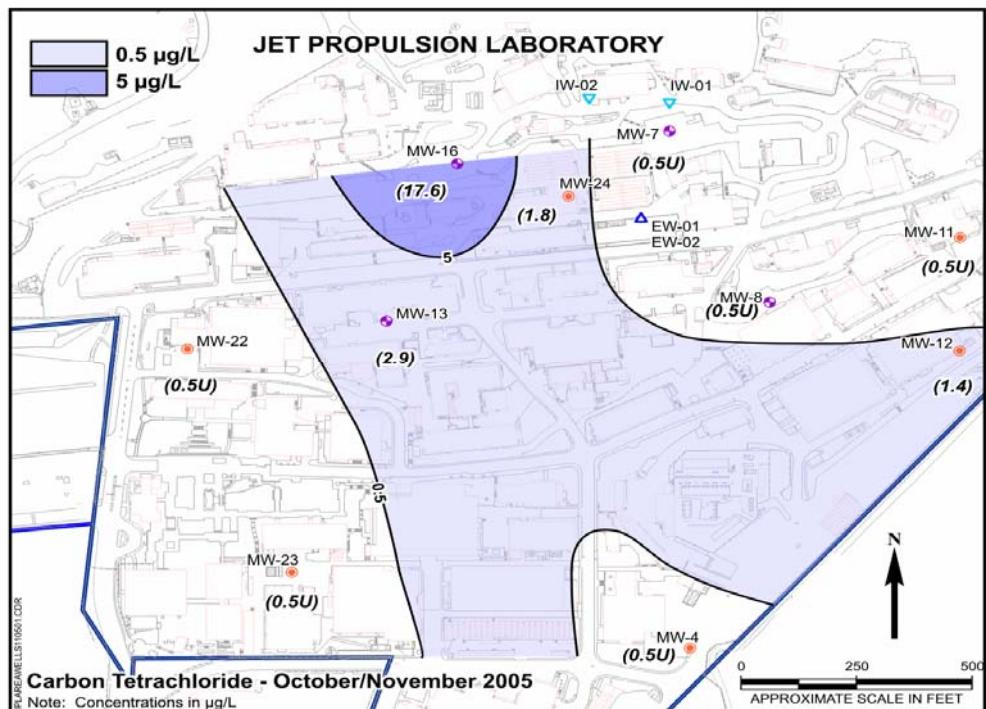
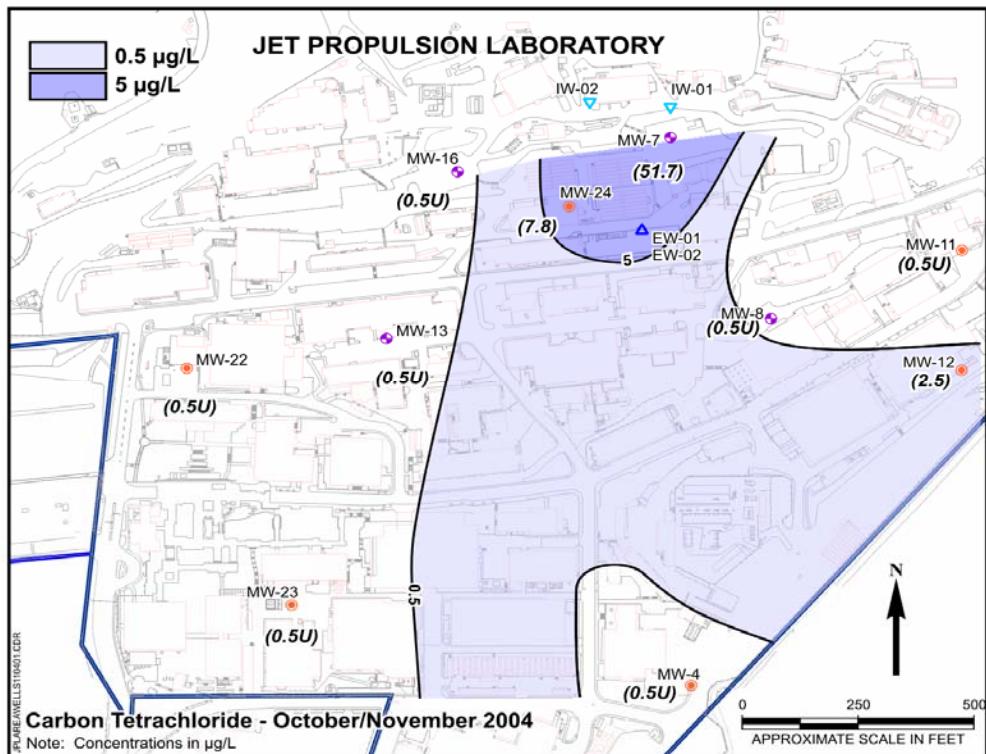


Figure 15. CCl_4 in Groundwater Before (October/November 2004) and After Extraction (October/November 2005)

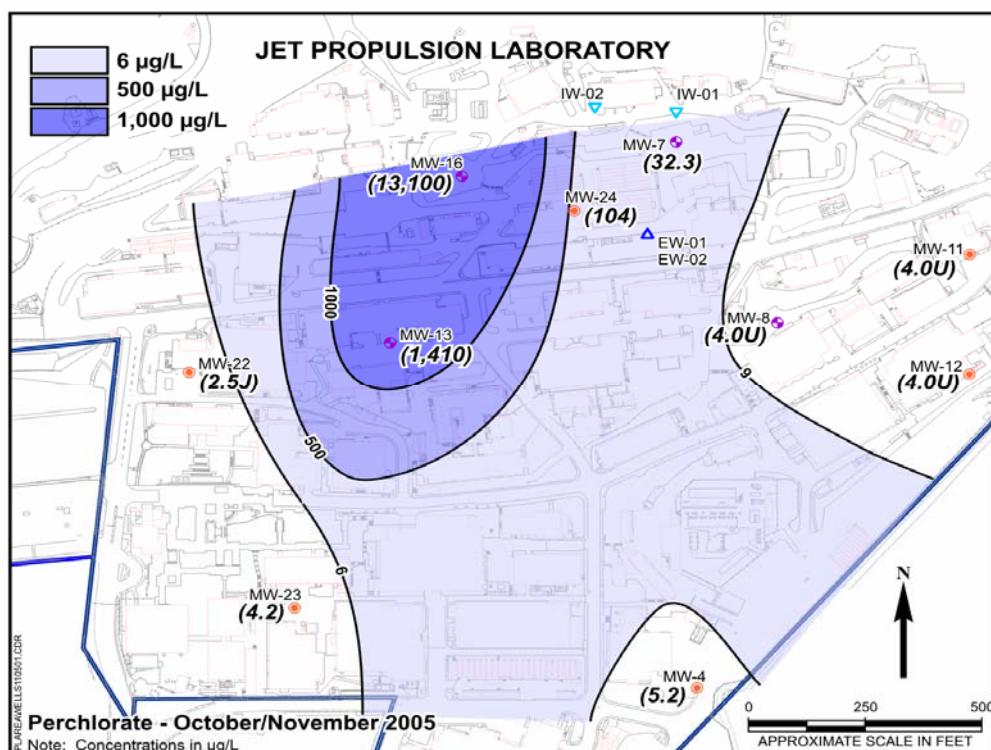
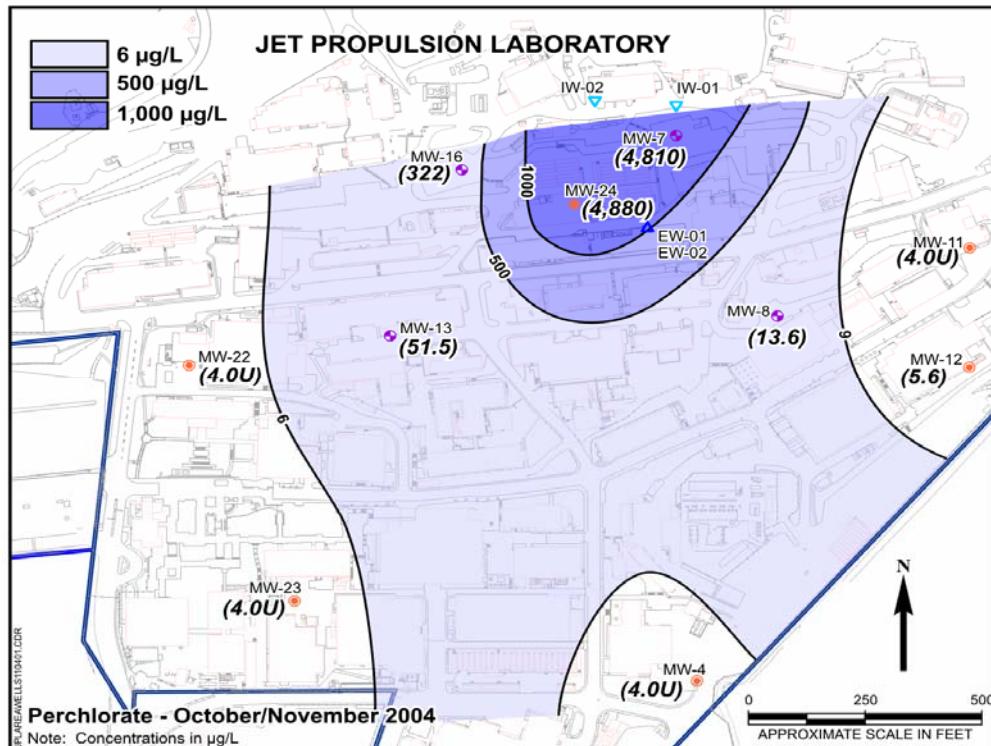


Figure 16. Perchlorate in Groundwater Before (October/November 2004) and After Extraction (October/November 2005)

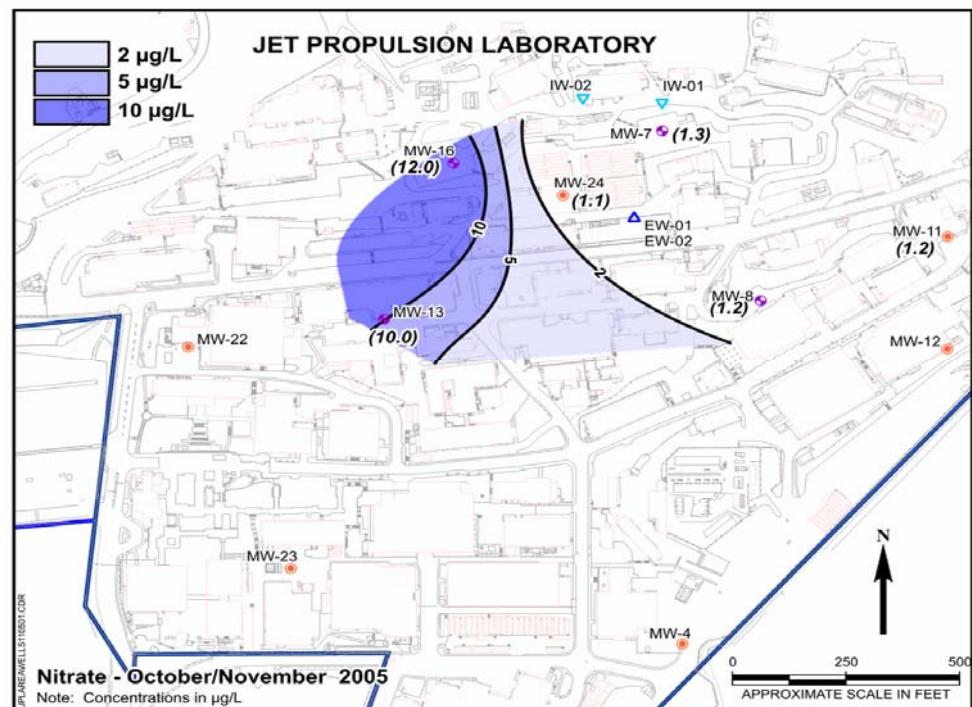
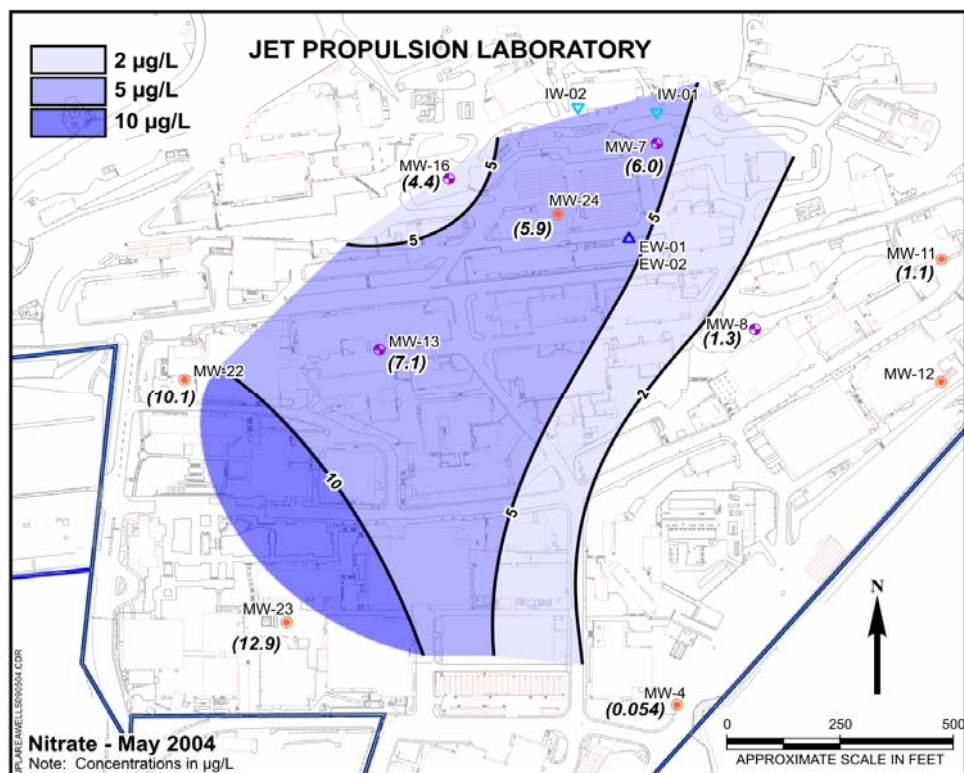


Figure 17. Nitrate in Groundwater Before (May 2004) and After Extraction (October/November 2005)

Conclusions and Recommendations:

Conclusions and recommendations associated with the OU-1 system performance during the September 2005 to February 2006 timeframe are as follows:

- Approximately 10 lb of carbon tetrachloride and 1.9 lb of TCE have been removed through February 28, 2006. VOC removal to non-detectable concentrations has been achieved at the effluent of the lag LGAC vessel through February 28, 2006. The lead LGAC vessel reached breakthrough for carbon tetrachloride on March 8, 2006 and will be changed out in April 2006.
- Approximately 432 lb of perchlorate have been removed since the start-up of the OU-1 system. The perchlorate removal was 100% for 52 out of 59 sampling events since system start-up. Under dosing of acetic acid and incomplete perchlorate removal (at an average of 60% removal) was experienced on September 15, September 29, 2005 and December 28, 2005. In January effluent concentrations of perchlorate were briefly detected in the 200-300 μ g/L using field instrumentation. The perchlorate laboratory results from the FBR effluent are received on a 24-hour turnaround basis to improve response time to changing process conditions.
- One event occurred during this timeframe in which sulfate reduction within the FBR resulted in measurable sulfide production. The sulfate reduction was countered by placing the system solely in recycling mode and rehabilitating the FBR through with batch dosing of nitrate. The newly installed, replacement, VGAC vapor phase system ensures that the system does not release any nuisance odors into the ambient air. H₂S concentrations in the ambient air are also measured daily at points within and nearby the OU-1 plant.
- The total volume sent to the clarifier to date is 57,000 gallons, or approximately 0.18 acre-ft.
- A well rehabilitation of IW-1 is currently planned for April 2006.
- A significant decrease in chemical concentrations has been observed in the vicinity of MW-7 and MW-24, which are located within the OU-1 system target treatment zone. Source area concentrations in MW-16 and MW-13 remain elevated while groundwater levels continue to recede from their historical high levels.

Attachment A

Field Monitoring Results

Table A-1. OU-1 On Site Water Quality Log Comparison Sheet FBR Influent and Effluent

Date	DO In	DO Out	ORP In	ORP Out	ClO ₄ In ^a	ClO ₄ Out ^a	Nitrate-N In	Nitrate-N Out
d/m/y	mg/L	mg/L	mV	mV	mg/L	mg/L	mg/L	mg/L
1-Sep-05	4.38	0.21	68.00	-525.1	0.19	0.02	2.90	0.00
6-Sep-05	6.02	0.06	90.20	-252.3	0.26	0.02	3.20	0.10
7-Sep-05	4.33	0.31	36.30	-246.5	0.25	0.03	3.00	-
8-Sep-05	3.84	0.09	37.70	-225.8	0.22	0.00	2.30	0.30
9-Sep-05	4.87	0.29	68.70	-225.8	0.20	0.00	2.80	-
19-Sep-05	4.58	0.18	72.40	-41.8	2.20	0.63	0.60	-
21-Sep-05	4.71	0.44	71.10	-74.8	0.31	0.07	0.70	0.30
22-Sep-05	6.60	0.39	82.30	-50.0	0.36	0.07	2.50	0.20
23-Sep-05	5.00	0.26	13.30	-35.9	0.28	0.04	-	-
26-Sep-05	4.21	0.29	83.10	-57.5	0.36	0.07	3.90	-
27-Sep-05	4.50	0.33	111.90	-82.2	0.38	0.08	3.80	0.53
28-Sep-05	4.96	0.60	94.10	-92.5	0.30	0.05	2.90	-
29-Sep-05	4.38	0.51	95.60	-39.0	-	-	-	-
3-Oct-05	5.00	0.32	109.20	50.1	0.29	0.19	2.00	-
4-Oct-05	4.41	0.34	123.10	-178.1	0.33	0.04	2.30	0.40
5-Oct-05	4.47	0.34	117.60	78.5	0.31	0.05	2.10	-
6-Oct-05	4.68	0.23	112.50	1.3	0.34	0.04	2.00	0.30
11-Oct-05	4.12	0.22	83.60	-58.70	0.32	0.03	2.40	0.30
12-Oct-05	4.96	0.17	115.80	-78.10	0.30	0.03	2.10	-
13-Oct-05	1.60	0.43	89.50	-224.90	0.16	0.11	1.40	-
17-Oct-05	2.95	0.26	87.10	-212.80	0.09	0.03	1.30	-
18-Oct-05	3.05	0.19	94.70	-92.90	0.08	0.07	1.70	0.20
19-Oct-05	2.15	0.20	92.90	-247.10	0.08	0.03	1.70	-
20-Oct-05	1.36	0.21	34.20	-234.00	0.08	0.04	3.40	0.00
21-Oct-05	1.81	0.29	29.30	-233.80	0.08	0.04	3.00	-
24-Oct-05	2.27	0.18	42.00	-243.40	0.09	0.04	2.50	-
26-Oct-05	3.10	0.18	95.80	-242.40	0.08	0.04	2.10	-
27-Oct-05	3.37	0.21	-53.80	-255.30	0.11	0.07	2.70	0.02
28-Oct-05	2.09	0.25	-50.10	-290.10	0.11	0.06	2.30	-
31-Oct-05	3.48	0.23	93.50	-261.10	0.21	0.16	4.20	-
1-Nov-05	1.67	0.18	69.90	-230.50	0.15	0.19	0.00	-
2-Nov-05	1.26	0.21	7.20	-309.80	0.08	0.19	1.30	-
3-Nov-05	1.17	0.17	-108.30	-290.00	0.07	0.19	1.00	0.00
4-Nov-05	1.58	0.25	-7.00	-278.40	0.08	0.19	1.10	-
7-Nov-05	1.98	0.31	-146.00	-270.60	0.07	0.11	2.30	-
8-Nov-05	2.44	0.21	-50.70	-248.00	0.06	0.05	0.50	0.00
9-Nov-05	4.15	0.29	63.50	-252.80	0.06	0.04	2.60	-
10-Nov-05	3.06	0.19	46.80	-96.30	0.07	0.04	2.90	0.00
11-Nov-05	3.61	0.21	58.80	-126.70	0.11	0.05	2.50	0.00
15-Nov-05	2.85	0.15	55.30	-232.40	0.08	0.04	3.30	0.00
16-Nov-05	2.99	0.17	-18.90	-254.40	0.08	0.04	0.60	-
17-Nov-05	2.76	0.14	53.50	-233.90	0.09	0.04	2.90	0.20

Table A-1. OU-1 On Site Water Quality Log Comparison Sheet FBR Influent and Effluent

Date	DO In	DO Out	ORP In	ORP Out	ClO ₄ In ^a	ClO ₄ Out ^a	Nitrate-N In	Nitrate-N Out
d/m/y	mg/L	mg/L	mV	mV	mg/L	mg/L	mg/L	mg/L
23-Nov-05	3.77	0.24	90.20	-227.20	0.16	0.04	2.50	-
28-Nov-05	2.62	0.15	70.40	-254.60	0.21	0.04	3.10	-
1-Dec-05	3.04	0.03	29.90	-225.70	0.24	0.03	3.40	0.00
2-Dec-05	2.34	0.22	88.90	-225.00	0.21	0.04	2.60	-
5-Dec-05	2.03	0.24	60.30	-259.40	0.23	0.13	2.60	-
6-Dec-05	2.03	0.20	79.50	-246.50	0.24	0.13	3.00	0.00
7-Dec-05	2.22	0.23	74.40	-225.80	0.25	0.03	3.00	-
8-Dec-05	2.11	0.37	37.40	-251.60	0.26	0.04	3.10	0.00
9-Dec-05	2.21	0.29	95.10	-216.00	0.28	0.04	3.50	-
12-Dec-05	2.05	0.14	136.20	-192.20	0.30	0.04	2.60	-
13-Dec-05	2.31	0.15	127.00	-99.70	0.31	0.06	3.00	0.30
14-Dec-05	1.89	0.14	134.80	-193.50	0.35	0.07	3.50	-
15-Dec-05	1.99	0.13	96.40	-194.20	0.35	0.05	3.10	0.50
20-Dec-05	0.63	0.06	73.30	-196.90	0.63	0.06	4.70	0.40
21-Dec-05	4.29	0.13	109.80	-226.00	0.34	0.03	2.30	-
22-Dec-05	1.94	0.10	111.50	-221.60	0.45	0.05	2.80	0.40
26-Dec-05	2.48	0.36	131.80	-287.60	0.32	0.11	2.40	-
27-Dec-05	2.32	0.16	92.70	-107.60	0.34	0.04	3.00	0.20
28-Dec-05	2.58	0.11	99.50	3.60	0.34	0.12	2.50	-
29-Dec-05	2.13	0.09	86.90	-218.30	0.40	0.05	2.70	0.70
3-Jan-06	2.74	0.20	107.20	86.10	0.47	0.31	3.20	2.90
4-Jan-06	2.92	0.17	41.00	-120.10	0.47	0.02	2.80	-
5-Jan-06	2.53	0.10	59.00	-110.30	0.45	0.03	3.10	0.70
6-Jan-06	2.50	0.10	103.70	-136.00	0.45	0.03	-	-
9-Jan-06	3.00	0.11	94.10	-66.70	0.61	0.04	2.80	-
10-Jan-06	2.10	0.19	108.80	-119.40	0.59	0.03	3.10	0.70
11-Jan-06	4.25	0.26	101.00	-107.00	0.52	0.03	3.00	-
12-Jan-06	2.69	0.12	110.80	-146.00	0.49	0.03	3.30	0.40
13-Jan-06	2.76	0.20	90.80	-174.50	0.50	0.03	2.30	-
16-Jan-06	3.09	0.12	103.10	-96.00	0.55	0.03	-	-
17-Jan-06	3.00	0.12	96.00	-224.10	0.57	0.05	2.40	0.60
18-Jan-06	3.30	0.16	86.20	-270.00	0.50	0.09	1.10	-
19-Jan-06	3.16	0.17	69.30	-276.60	0.51	0.11	2.00	0.50
24-Jan-06	3.15	0.18	-38.00	-289.10	0.44	0.19	3.80	2.50
25-Jan-06	3.00	0.16	43.00	-274.90	0.44	0.16	2.70	2.40
26-Jan-06	3.30	0.18	57.50	-279.10	0.37	0.12	3.30	2.50
31-Jan-06	2.89	0.22	42.20	-89.40	0.32	0.05	3.40	0.50
1-Feb-06	2.72	0.14	39.10	-186.40	0.34	0.04	2.80	0.40
2-Feb-06	3.02	0.15	51.40	-157.50	0.32	0.04	3.10	0.90
3-Feb-06	2.99	0.16	50.60	-160.40	0.32	0.04	3.00	-
6-Feb-06	2.58	0.14	-1.50	-134.00	0.38	0.05	2.70	0.00
7-Feb-06	2.77	0.17	-10.90	-176.70	0.41	0.05	2.90	0.50

Table A-1. OU-1 On Site Water Quality Log Comparison Sheet FBR Influent and Effluent

Date	DO In	DO Out	ORP In	ORP Out	ClO ₄ In ^a	ClO ₄ Out ^a	Nitrate-N In	Nitrate-N Out
d/m/y	mg/L	mg/L	mV	mV	mg/L	mg/L	mg/L	mg/L
10-Feb-06	2.38	0.18	62.20	-138.40	0.41	0.06	2.90	0.40
13-Feb-06	2.75	0.20	150.00	-43.90	0.43	0.06	3.40	0.50
14-Feb-06	2.72	0.18	88.70	-85.60	0.32	0.06	3.00	0.70
16-Feb-06	3.29	0.18	89.70	-73.60	0.31	0.13	3.20	0.50
17-Feb-06	3.40	0.12	94.00	-100.50	0.34	0.07	0.31	0.50
20-Feb-06	3.32	0.19	99.20	-146.10	0.35	0.06	2.30	0.60
21-Feb-06	3.11	0.18	107.30	-122.90	0.35	0.06	2.10	0.70
22-Feb-06	2.99	0.14	101.60	-175.20	0.33	0.06	2.20	0.50
23-Feb-06	3.00	0.11	89.00	-193.90	0.32	0.07	3.20	0.40
24-Feb-06	2.89	0.20	89.50	-167.60	0.33	0.06	3.20	0.40
27-Feb-06	3.31	0.12	110.1	-199.30	0.37	0.06	2.50	0.30
28-Feb-06	3.27	0.12	75.5	-128.40	0.33	0.06	2.80	0.80

Note:

- (a) The ion selective probe for perchlorate is calibrated to <0.1 mg/L. Readings below this value are estimates
- (b) Samples shaded red are possible monitoring/equipment errors and are not included in calculations.
- (c) A dash signifies parameters that were not read.
- (d) UR = Under Range

Table A-2. OU-1 On Site Water Quality Log Sheet FBR Effluent

Date	Time	pH	Temperature	Conductivity	DO	ORP	ClO4 ^a	Sulfide ^b	Nitrate-N	Nitrite-N	Sulfate	Ammonia-N	PO ₄ ^c	Filtered TOC
d/m/y		°C	µS/cm	mg/L	mV	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1-Sep-05	1430	6.8	21.2	531	0.21	-525.1	0.02	36	0	0.003	39	0.8	1.69	4.2
6-Sep-05	1110	6.7	20.4	529	0.06	-252.3	0.02	86	0.1	0.004	40	0.9	1.21	3.9
7-Sep-05	1400	6.7	20.6	528	0.31	-246.5	0.03	-	-	-	-	-	-	-
8-Sep-05	1750	6.7	20.5	527	0.09	-225.8	0.00	53	0.3	0.006	40	0.8	1.29	2
9-Sep-05	850	6.9	19.4	528	0.29	-225.8	0.00	-	-	-	-	-	-	-
19-Sep-05	1600	7.5	21.4	535	0.18	-41.8	0.63	-	-	-	-	-	-	-
21-Sep-05	1635	7.2	20.9	532	0.44	-74.8	0.07	23	0.3	0.005	42	0.9	1.41	3.4
22-Sep-05	1300	7.5	20.6	533	0.39	-50.0	0.07	14	0.2	0.003	35	1.2	1.55	-
23-Sep-05	1045	7.4	21.0	533	0.26	-35.9	0.04	-	-	-	-	-	-	-
26-Sep-05	1400	7.6	21.3	525	0.29	-57.5	0.07	-	-	-	-	-	-	-
27-Sep-05	1500	7.5	21.1	526	0.33	-82.2	0.08	15	0.53	0.0006	30	1.05	1.47	2.2
28-Sep-05	1030	7.1	21.5	526	0.60	-92.5	0.05	-	-	-	-	-	-	-
29-Sep-05	1430	-	23.3	-	0.51	-39.0	-	-	-	-	-	-	-	-
3-Oct-05	1230	7.78	20.6	539	0.32	50.1	0.19	-	-	-	-	-	-	-
4-Oct-05	1310	7.27	20.7	528	0.34	-178.1	0.04	18	0.4	0.005	37	0.5	0.84	2.9
5-Oct-05	1530	7.47	20.1	532	0.34	78.5	0.05	-	-	-	-	-	-	-
6-Oct-05	1820	7.26	20.0	531	0.23	1.3	0.04	18	0.3	0.006	43	0.6	1.41	2.6
11-Oct-05	1520	7.01	20.6	523	0.22	-58.7	0.03	0.19	0.3	0.006	44	0.4	1.29	3.9
12-Oct-05	1750	7.02	20.2	518	0.17	-78.1	0.03	-	-	-	-	-	-	-
13-Oct-05	1650	6.53	21.6	606	0.43	-224.9	0.11	-	-	-	-	-	-	-
17-Oct-05	1415	7.30	21.1	525	0.26	-212.8	0.03	-	-	-	-	-	-	-
18-Oct-05	1630	7.84	20.2	572	0.19	-92.9	0.07	21	0.2	0.001	38	2.3	1.86	-
19-Oct-05	1315	7.35	20.0	524	0.20	-247.1	0.03	-	-	-	-	-	-	-
20-Oct-05	1520	7.87	20.9	534	0.21	-234.0	0.04	31	0	0.002	38	1.1	1.56	6.5
21-Oct-05	1300	7.76	20.8	531	0.29	-233.8	0.04	-	-	-	-	-	-	-
24-Oct-05	1245	6.88	19.6	535	0.18	-243.4	0.04	-	-	-	-	-	-	-
26-Oct-05	1820	6.79	19.4	534	0.18	-242.4	0.04	-	-	-	-	-	-	-
27-Oct-05	1840	6.96	19.4	525	0.21	-255.3	0.07	32	0.02	0.004	39	0.2	1.47	7.1
28-Oct-05	1200	6.85	19.4	525	0.25	-290.1	0.06	-	-	-	-	-	-	-
31-Oct-05	1750	6.83	21.0	530	0.23	-261.1	0.16	-	-	-	-	-	-	-
1-Nov-05	1830	-	-	0.18	-	-230.5	0.19	-	-	-	-	-	-	-
2-Nov-05	1730	7.10	20.5	539	0.21	-309.8	0.19	-	-	-	-	-	-	-
3-Nov-05	1730	7.32	20.5	539	0.17	-290.0	0.19	262	0.00	0	33	0.6	1.64	9.1
4-Nov-05	1200	7.29	20.3	539	0.25	-278.4	0.19	-	-	-	-	-	-	-
7-Nov-05	1245	7.59	20.3	527	0.31	-270.6	0.11	-	-	-	-	-	-	-
8-Nov-05	1230	7.26	19.5	526	0.21	-248.0	0.05	86	0.00	0.004	41	0	0.31	4.5
9-Nov-05	1745	7.36	19.6	530	0.29	-252.8	0.04	-	-	-	-	-	-	-
10-Nov-05	1200	7.28	20.0	531	0.19	-96.3	0.04	105	0.00	0.002	41	1.2	1.62	3.3
11-Nov-05	1545	7.33	19.9	533	0.21	-126.7	0.05	-	0.00	-	-	-	-	-
15-Nov-05	1145	7.35	20.9	536	0.15	-232.4	0.04	51	0	0.004	42	1.1	1.63	3.8
16-Nov-05	1520	7.35	21.0	556	0.17	-254.4	0.04	-	-	-	-	-	-	-
17-Nov-05	1500	7.36	20.7	527	0.14	-233.9	0.04	33	0.2	0.005	39	0.05	1.21	3.1
21-Nov-05	1310	7.33	20.5	528	0.22	-224.4	0.04	-	-	-	-	-	-	-
22-Nov-05	1420	7.63	20.6	527	0.27	-256.7	0.04	44	0	0.003	36	0.4	1.2	3.3
23-Nov-05	1400	7.54	20.6	527	0.24	-227.2	0.04	-	-	-	-	-	-	-
28-Nov-05	1500	7.86	19.6	529	0.15	-254.6	0.04	-	-	-	-	-	-	-
1-Dec-05	1400	6.89	20.0	533	0.03	-225.7	0.03	44	0	0.006	35	0.6	1.1	4.3
2-Dec-05	1545	7.35	20.1	532	0.22	-225.0	0.04	-	-	-	-	-	-	-
5-Dec-05	1400	6.51	19.8	532	0.24	-259.4	0.13	-	-	-	-	-	-	-
6-Dec-05	1155	7.25	19.8	534	0.20	-246.5	0.13	51	0	0.003	37	0.1	0.24	4.2
7-Dec-05	1145	7.24	19.9	548	0.23	-225.8	0.03	-	-	-	-	-	-	-
8-Dec-05	1615	7.31	18.6	544	0.37	-251.6	0.04	29	0	0.003	38	2.1	2.31	2.3
9-Dec-05	1230	7.23	19.8	539	0.29	-216.0	0.04	-	-	-	-	-	-	-
12-Dec-05	1315	7.16	19.8	538	0.14	-192.2	0.04	-	-	-	-	-	-	-
13-Dec-05	1320	7.56	19.9	569	0.15	-99.7	0.06	26	0.3	0.003	37	1.4	1.33	3.6
14-Dec-05	1335	7.74	19.6	581	0.14	-193.5	0.07	-	-	-	-	-	-	-
15-Dec-05	1825	7.24	19.4	549	0.13	-194.2	0.05	18	0.5	0.005	37	1.1	1.35	3.8
20-Dec-05	1730	7.43	20.6	567	0.06	-196.9	0.06	62	0.4	0.007	31	2.5	1.41	-
21-Dec-05	1830	6.98	20.7	510	0.13	-226.0	0.03	-	-	-	-	-	-	-
22-Dec-05	1800	7.07	20.4	496	0.10	-221.6	0.05	25	0.4	0.008	38	0.8	1.13	3.4
26-Dec-05	1230	7.07	19.9	529	0.36	-287.6	0.11	-	-	-	-	-	-	-
27-Dec-05	1230	7.36	20.0	546	0.16	-107.6	0.04	13	0.2	0.006	41	2.2	1.21	2.8
28-Dec-05	1830	7.42	18.8	558	0.11	3.6	0.12	-	-	-	-	-	-	-
29-Dec-05	1615	7.28	19.8	555	0.09	-218.3	0.05	10	0.7	0.007	35	0.8	1.02	4.1
3-Jan-06	1700	7.28	19.4	568	0.20	86.1	0.31	3	2.9	0.482	40	0.6	0.8	4.1
4-Jan-06	1620	7.00	20.7	504	0.17	-120.1	0.02	-	-	-	-	-	-	-
5-Jan-06	1840	6.91	20.0	503	0.10	-110.3	0.03	4	0.7	0.007	39	1	1.13	3.3
6-Jan-06	1900	6.85	20.0	515	0.10	-136.0	0.03	-	-	-	-	-	-	-
9-Jan-06	1630	7.22	19.9	537	0.11	-66.7	0.04	-	-	-	-	-	-	-

Table A-2. OU-1 On Site Water Quality Log Sheet FBR Effluent

Date	Time	pH	Temperature	Conductivity	DO	ORP	ClO4 ^a	Sulfide ^b	Nitrate-N	Nitrite-N	Sulfate	Ammonia-N	PO4 ^c	Filtered TOC
d/m/y		°C	µS/cm	mg/L	mV	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10-Jan-06	1830	6.98	19.6	511	0.19	-119.4	0.03	-	0.7	0.001	-	0.4	1.03	-
11-Jan-06	1320	7.05	19.9	517	0.26	-107.0	0.03	-	-	-	-	-	-	-
12-Jan-06	1445	7.03	20.4	512	0.12	-146.0	0.03	9	0.4	0.003	35	1	1.3	4.7
13-Jan-06	1100	6.91	19.8	506	0.20	-174.5	0.03	-	-	-	-	-	-	-
16-Jan-06	1655	-	-	-	0.12	-96.0	0.03	-	-	-	-	-	-	-
17-Jan-06	1330	6.89	18.9	456	0.12	-224.1	0.05	22	0.6	0.004	36	0.8	1.35	3.5
18-Jan-06	1400	6.94	18.5	506	0.16	-270.0	0.09	-	-	-	-	-	-	-
19-Jan-06	1415	7.18	18.8	519	0.17	-276.6	0.11	871	0.5	0.003	35	1.1	1.4	5.6
24-Jan-06	1400	7.27	18.7	532	0.18	-289.1	0.19	1000	2.5	0.003	31	1.1	1.49	4.3
25-Jan-06	1130	7.20	19.1	530	0.16	-274.9	0.16	1000	2.4	-	-	-	-	-
26-Jan-06	1200	7.11	19.8	531	0.18	-279.1	0.12	1000	2.5	0.004	35	1.4	1.45	4.5
31-Jan-06	1030	7.48	19.0	551	0.22	-89.4	0.05	10	0.5	0.003	43	0.6	0.39	3.9
1-Feb-06	1200	7.24	19.8	535	0.14	-186.4	0.04	13	0.4	-	-	-	-	-
2-Feb-06	1035	7.15	19.6	527	0.15	-157.5	0.04	16	0.9	0.005	43	0.2	0.49	4.1
3-Feb-06	1100	7.17	19.6	526	0.16	-160.4	0.04	-	-	-	-	-	-	-
6-Feb-06	1240	7.08	20.8	528	0.14	-134.0	0.05	-	0	-	-	-	-	-
7-Feb-06	1320	7.21	20.6	531	0.17	-176.7	0.05	13	0.5	0.004	35	0.9	1.54	2.9
8-Feb-06	1125	7.10	20.9	523	0.23	-186.4	0.05	-	0.5	-	-	-	-	-
9-Feb-06	1110	7.25	19.6	525	0.24	-163.8	0.05	7	0.4	0.004	38	0.73	0.3	4.3
10-Feb-06	1220	7.37	20.9	549	0.18	-138.4	0.06	-	0.4	-	-	-	-	-
13-Feb-06	1120	7.16	21.1	540	0.20	-43.9	0.06	-	0.5	-	-	-	-	-
14-Feb-06	1205	7.08	20.4	543	0.18	-85.6	0.06	2	0.7	0.005	42	1.3	1.56	2.9
16-Feb-06	1010	7.43	19.2	544	0.18	-73.6	0.13	0	0.5	0.004	40	0.5	1.46	5.1
17-Feb-06	1615	7.21	19.3	536	0.12	-100.5	0.07	-	0.5	-	-	-	-	-
20-Feb-06	1210	7.00	19.6	512	0.19	-146.1	0.06	-	0.6	-	-	-	-	-
21-Feb-06	1040	7.04	19.5	521	0.18	-122.9	0.06	9	0.7	0.003	36	0.9	1.16	4.3
22-Feb-06	1050	7.11	19.6	511	0.14	-175.2	0.06	-	0.5	-	-	-	-	-
23-Feb-06	1515	6.99	21.2	517	0.11	-193.9	0.07	13	0.4	0.006	40	-	1.15	3.5
24-Feb-06	1110	7.04	20.3	522	0.20	-167.6	0.06	-	0.4	-	-	-	-	-
27-Feb-06	1100	6.89	19.5	527	0.12	-199.3	0.06	-	0.3	-	-	-	-	-
28-Feb-06	1120	6.75	20.0	527	0.12	-128.4	0.06	10	0.8	0.005	40	-	1.35	3.3
1-Mar-06	1630	7.12	20.6	530	0.13	-172.8	0.06	-	0.6	-	-	-	-	-
2-Mar-06	1335	7.28	20.5	553	0.13	-136.8	0.07	8	0.8	0.004	44	-	1.8	3.1
3-Mar-06	1000	7.21	20.4	550	0.13	-89.4	0.07	-	0.5	-	-	-	-	-

Note:

(a) The ion selective probe for perchlorate is calibrated to <0.1 mg/L. Readings below this value are estimates or "J" values.

(b) Samples shaded red are possible monitoring/equipment errors and are not included in calculations.

(c) A dash signifies parameters that were not read.

(d) UR = Under Range

Attachment B

Laboratory Analytical Results

Table B-1. Laboratory Analytical Data OU-1 Treatment System - September 2005

Table B-1. Laboratory Analytical Data OU-1 Treatment System - October 2005

Table B-1. Laboratory Analytical Data OU-1 Treatment System - November 2005

Sampling Date		11/3/2005						11/9/2005						11/17/2005						11/22/2005							
Sample Locations		EW-1	EW-2	GACIN	GACMD	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMD	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMD	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMD	FBR Inlet	FBR Outlet		
Parameter	Unit																										
Conductivity	µS/cm	530	540	530	-	530	530	510	530	520	-	530	510	510	530	530	-	530	520	500	520	510	-	520	500		
Perchlorate	µg/L	287	541	417	-	<2.00	<2.00	298	529	423	-	2.02	<2.00	258	478	376	-	67	<2.00	257	480	407	-	204	<2.00		
Nitrite	mg/L	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25		
Nitrate	mg/L	3.1	3.2	3.2	-	1.7	<0.25	3.0	3.2	3.1	-	2.7	<0.25	2.7	2.9	2.8	-	2.5	<0.25	2.6	2.9	2.8	-	2.5	<0.25		
Sulfate	mg/L	50	44	47	-	46	41	50	44	46	-	47	47	49	43	45	-	46	44	49	43	45	-	46	44		
Chlorate	mg/L	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5		
Chloride	mg/L	28	30	29	-	29	29	28	30	29	-	29	30	28	31	29	-	29	29	28	31	29	-	29	29		
Sulfide	mg/L	-	-	-	-	<0.10	2.40	-	-	-	-	<0.10	0.48	-	-	-	-	<0.10	0.3	-	-	-	-	<0.10	0.52		
TOC	mg/L	-	-	-	-	-	7.8	-	-	-	-	-	1.8	-	-	-	-	-	1.4	-	-	-	-	-	-	1.6	
TKN	mg/L	-	-	-	-	3.20	1.70	-	-	-	-	1.00	0.72	-	-	-	-	-	1.70	1.3	-	-	-	-	-	1.80	1.0
Phosphorus	mg/L	0.15	0.21	0.18	-	0.29	0.63	0.20	0.22	0.16	-	0.28	0.24	0.14	0.23	0.15	-	0.34	0.43	0.14	0.15	0.18	-	0.27	0.40		
Alkalinity	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TDS	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	310	-	-	-	-	-	-	330	-
TSS	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.0	-	-	-	-	-	-	3.5	-
Turbidity	NTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BOD	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
COD	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1,1-Dichloroethene	µg/L	<1.0	1.1	<1.0	<1.0	<1.0	-	<1.0	1.1	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-		
Chloroform	µg/L	1.2	3.5	2.5	<1.0	<1.0	-	1.0	3.7	2.5	<1.0	<1.0	-	<1.0	3.0	2.3	<1.0	<1.0	-	<1.0	2.9	2.2	<1.0	<1.0	-		
Carbon Tetrachloride	µg/L	1.5	21	12	<1.0	<1.0	-	1.1	22	13	<1.0	<1.0	-	1.0	15	10	<1.0	<1.0	-	<1.0	14	10	<1.0	<1.0	-		
Trichloroethene	µg/L	1.0	3.5	2.4	<1.0	<1.0	-	<1.0	3.6	2.4	<1.0	<1.0	-	<1.0	2.6	2.0	<1.0	<1.0	-	<1.0	2.6	2.0	<1.0	<1.0	-		
Tetrachloroethene	µg/L	<1.0	2.3	1.4	<1.0	<1.0	-	<1.0	2.3	1.4	<1.0	<1.0	-	<1.0	1.6	1.2	<1.0	<1.0	-	<1.0	1.7	1.3	<1.0	<1.0	-		
Total VOC's	µg/L	3.7	31.4	18.3	0.0	0.0	-	2.1	32.7	19.3	0.0	0.0	-	1.0	22.2	15.5	0.0	0.0	-	0.0	21.2	15.5	0.0	0.0	-		
1,4-Dioxane	µg/L	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0	-	5.6	5.1	4.9	5.0	5.3	-	<3.0	<3.0	<3.0	<3.0	<3.0	-		

Table B-1. Laboratory Analytical Data OU-1 Treatment System - December 2005

Table B-1. Laboratory Analytical Data OU-1 Treatment System - January 2006

Sampling Date		1/5/2006						1/13/2006						1/18/2006					
Sample Locations		EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet
Parameter	Unit																		
Conductivity	µS/cm	520	540	530	-	530	500	490	520	510	-	510	470	500	510	510	-	510	490
Perchlorate	µg/L	229	554	410	-	475	<2.00	243	540	397	-	509	<2.00	259	564	428	-	501	<2.00
Nitrite	mg/L	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25
Nitrate	mg/L	2.4	3.2	2.9	-	2.7	<0.25	2.5	3.2	2.9	-	2.6	<0.25	2.5	3.2	2.9	-	2.6	<0.25
Sulfate	mg/L	48	43	45	-	46	42	48	43	46	-	45	43	48	43	46	-	46	42
Chlorate	mg/L	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-
Chloride	mg/L	28	31	30	-	30	30	28	31	30	-	31	31	29	31	30	-	31	31
Sulfide	mg/L	-	-	-	-	<0.10	0.16	-	-	-	-	<0.10	0.14	-	-	-	-	<0.10	3.10
TOC	mg/L	-	-	-	-	-	1.8	-	-	-	-	-	<1.0	-	-	-	-	-	3.2
TKN	mg/L	-	-	-	-	1.10	0.98	-	-	-	-	0.63	1.50	-	-	-	-	0.66	1.40
Phosphorus	mg/L	<0.10	0.13	0.11	-	0.23	0.40	<0.10	<0.10	<0.10	-	0.26	0.37	0.17	0.12	0.13	-	0.22	0.40
Alkalinity	mg/L	-	-	-	-	150	-	-	-	-	-	1300	-	-	-	-	-	160	-
TDS	mg/L	-	-	-	-	320	-	-	-	-	-	320	-	-	-	-	-	310	-
TSS	mg/L	-	-	-	-	<2.5	-	-	-	-	-	3.8	-	-	-	-	-	<2.5	-
Turbidity	NTU	-	-	-	-	0.21	-	-	-	-	-	0.76	-	-	-	-	-	0.23	-
BOD	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
COD	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1,1-Dichloroethene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	1.1	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	
Chloroform	µg/L	<1.0	3.0	2.0	<1.0	<1.0	-	<1.0	2.5	1.7	<1.0	<1.0	-	<1.0	2.9	2.0	<1.0	<1.0	
Carbon Tetrachloride	µg/L	<1.0	18	11	<1.0	<1.0	-	<1.0	16.0	8.8	<1.0	<1.0	-	<1.0	16	9.0	<1.0	<1.0	
Trichloroethene	µg/L	<1.0	3.1	1.9	<1.0	<1.0	-	<1.0	2.4	1.4	<1.0	<1.0	-	<1.0	2.8	1.7	<1.0	<1.0	
Tetrachloroethene	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	1.4	<1.0	<1.0	<1.0	-	<1.0	1.6	1.0	<1.0	<1.0	
Total VOC's	µg/L	0.0	24.1	14.9	0.0	0.0	0.0	0.0	23.4	11.9	0.0	0.0	0.0	0.0	23.3	13.7	0.0	0.0	
1,4-Dioxane	µg/L	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0	

Table B-1. Laboratory Analytical Data OU-1 Treatment System - February 2006

Sampling Date		2/2/2006								2/9/2006								2/17/2006								2/24/2006							
Sample Locations		EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet	TRIMITE INLET	TRIMITE OUTLET	EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet	EW-1	EW-2	GACIN	GACMID	FBR Inlet	FBR Outlet						
Parameter	Unit																																
Conductivity	µS/cm	210	530	510	-	520	500	-	-	510	540	530	-	530	510	520	540	530	-	520	530	6400	530	520	-	510	520						
Perchlorate	µg/L	231	509	387	-	401	<2.00	-	-	231	515	372	-	399	<2.00	244	537	393	-	404	<2.00	260	539	410	-	426	<2.00						
Nitrite	mg/L	<0.25	<0.25	<0.25	-	<0.25	<0.25	-	-	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25					
Nitrate	mg/L	2.3	3.3	2.8	-	2.6	<0.25	-	-	2.2	3.3	2.8	-	2.6	<0.25	2.1	3.3	2.7	-	2.5	<0.25	2.1	3.4	2.8	-	2.5	<0.25						
Sulfate	mg/L	48	43	45	-	46	45	-	-	48	43	45	-	46	45	47	42	44	-	45	42	47	42	45	-	45	44						
Chlorate	mg/L	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5						
Chloride	mg/L	29	32	30	-	30	30	<2.5	3.5	31	32	31	-	31	31	28	32	30	-	30	30	29	32	31	-	31	31						
Sulfide	mg/L	-	-	-	-	<.10	<0.10	-	-	-	-	-	-	<0.10	<0.10	-	-	-	-	<0.10	0.15	-	-	-	-	<0.10	<0.10						
TOC	mg/L	-	-	-	-	-	<1.0	-	-	-	-	-	-	-	<1.0	-	-	-	-	-	1.2	-	-	-	-	-	<1.0						
TKN	mg/L	-	-	-	-	0.28	0.51	-	-	-	-	-	-	0.46	1.60	-	-	-	-	2.70	2.20	-	-	-	-	1.60	1.80						
Phosphorus	mg/L	0.21	0.22	0.15	-	0.37	0.44	-	-	0.13	0.15	0.14	-	0.19	0.26	0.16	<0.10	<0.10	-	0.20	0.49	0.23	0.15	0.16	-	0.27	0.42						
Alkalinity	mg/L	-	-	170	-	170	-	170	170	-	-	-	-	170	-	-	-	-	-	170	-	-	-	-	-	-	160	-					
TDS	mg/L	-	-	320	-	320	320	330	320	-	-	-	-	310	-	-	-	-	-	310	-	-	-	-	-	-	310	-					
TSS	mg/L	-	-	<2.5	-	<2.5	-	4	<2.5	-	-	-	-	<2.5	-	-	-	-	-	<0.50	-	-	-	-	-	-	3.5	-					
Turbidity	NTU	-	-	<0.10	-	0.24	-	0.82	<0.10	-	-	-	-	0.20	-	-	-	-	-	0.26	-	-	-	-	-	-	0.20	-					
BOD	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COD	mg/L	-	-	<5.0	-	-	-	-	<5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
1,1-Dichloroethene	µg/L	<1.0	1.0	<1.0	<1.0	<1.0	<1.0	-	-	<1.0	1.1	<1.0	<1.0	<1.0	-	<1.0	1.0	<1.0	<1.0	<1.0	-	<1.0	1.1	<1.0	<1.0	<1.0	<1.0						
Chloroform	µg/L	<1.0	3.2	2.1	1.3	<1.0	-	-	-	<1.0	3.3	2.2	1.6	<1.0	-	<1.0	3.1	2.1	1.7	<1.0	-	<1.0	3.3	2.1	1.9	<1.0	-						
Carbon Tetrachloride	µg/L	<1.0	22	13	<1.0	<1.0	-	-	-	<1.0	20.0	11.0	<1.0	<1.0	-	<1.0	20	12	<1.0	<1.0	-	<1.0	22	12	<1.0	<1.0	-						
Trichloroethene	µg/L	<1.0	3.1	1.8	<1.0	<1.0	-	-	-	<1.0	3.3	1.9	<1.0	<1.0	-	<1.0	3.2	1.9	<1.0	<1.0	-	<1.0	3.5	2.0	<1.0	<1.0	-						
Tetrachloroethene	µg/L	<1.0	1.8	1.1	<1.0	<1.0	-	-	-	<1.0	2.0	1.3	<1.0	<1.0	-	<1.0	2.1	1.5	<1.0	<1.0	-	<1.0	2.3	1.5	<1.0	<1.0	-						
Total VOC's	µg/L	0.0	31.1	18.0	1.3	0.0	0.0	0.0	0.0	0.0	29.7	16.4	1.6	0.0	0.0	0.0	29.4	17.5	1.7	0.0	0.0	0.0	32.2	17.6	1.9	0.0	0.0						
1,4-Dioxane	µg/L	<3.0	<3.0	<3.0	<3.0	<3.0	-	-	-	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0	<3.0	<3.0	<3.0							

Table B-2. Summary of Laboratory Analytical for Metals

Sampling Date		9/29/2005		10/27/2005		12/8/2005		12/28/2005		2/2/2006	
Sampling Location		GACIN	Trinitite Outlet	GACIN	Trinitite Outlet	GACIN	Trinitite Outlet	GACIN	Trinitite Outlet	GACIN	Trinitite Outlet
Parameter	Unit										
Beryllium	mg/L	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.004
Magnesium	mg/L	19	21	-	20	20	21	18	18	18	17
Calcium	mg/L	58	69	-	65	66	68	58	59	62	59
Vanadium	mg/L	0.0036	0.022	0.0040	<0.0030	0.0032	<0.0030	0.0035	<0.0030	<0.0030	<0.0030
Chromium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Hexavalent Chromium	mg/L	2.2	<1.0	-	-	2.0	<1.0	2.6	<1.0	-	-
Manganese	mg/L	<0.0050	<0.0050	<0.0050	0.0074	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Iron	mg/L	0.50	0.60	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Cobalt	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Selenium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum	mg/L	0.0068	0.0092	0.011	<0.0050	0.013	0.0066	0.0075	0.0059	0.0093	0.0074
Silver	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium	mg/L	0.067	0.069	0.074	0.079	0.072	0.074	0.066	0.065	0.150	0.073
Mercury	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Thallium	mg/L	<0.0020	<0.0020	0.0053	<0.0020	0.0073	<0.0020	0.0033	<0.0020	0.0053	<0.0020
Lead	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Note:

(a) Sample taken from FBR outlet.